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Trouble-shooting instructions	: MB-5017
BOSCH system	: KE 3.1-Jetronic
Vehicle make	: MERCEDES-BENZ
Basic microcard	: PKW-014

Tests without coordinate references are not included in these trouble-shooting instructions.

SPECIAL FEATURES

* This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following Mercedes-Benz model:

  190 E 2.3-16,2,3 l / 4Zyl.(USA) 09.85->

* Trouble-shooting with these instructions may only then take place when the details of the "Summary - Service Information for Vehicles" (KFZ-000) coincide with those of the vehicle type and with the BOSCH number of the KE-Jetronic control unit installed.

* Control unit using digital techniques, characteristic-map control using microprocessor.

* Electronically controlled low-idle-speed control with single-winding rotary actuator, without bypass adjusting screw.

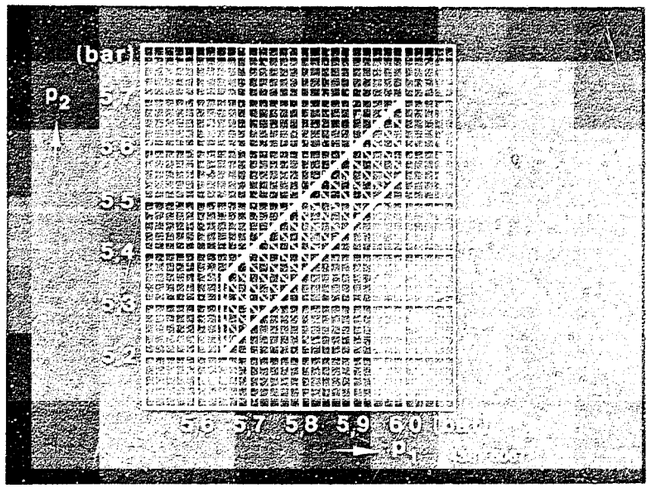
* Activated-carbon filter and regeneration valve for return of gasoline vapors into the intake manifold. (Fuel evaporation system)

Important note:

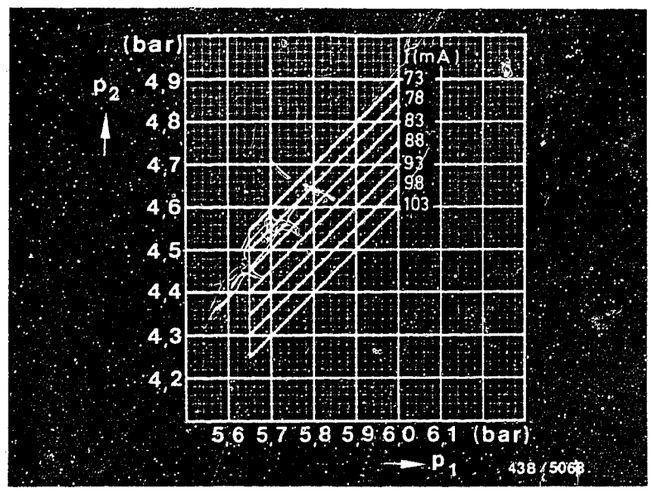
If reference is made to a basic microcard, always make sure you use the test specifications from the vehicle-specific brief instructions.

TEST SPECIFICATIONS

No.	Testing/Test condition	Test specification	
1	Electric fuel pump – fuel delivery:	At least 1350 cm ^{3} /min	
2	Primary pressure:	5,65...6,0 bar	
3	Differential pressure: Suppression of peak coil current: Actuate starting motor with fuel-pump relay disconnected. Do not switch off ignition after starting. Take lower-chamber pressure set value "warm" from top chart corresponding to primary pressure measured. (Actuator current 0 mA) Take lower-chamber pressure set value "cold" from bottom chart corresponding to primary pressure measured and actuator current. Tolerance ± 0.15 bar. Simulation of "cold" state: press push-button 3 at test adapter.		
4	Leakage test, complete system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 2,7 bar 2,6 bar	
5	Injection valves, opening pressure:	3,0...4,1 bar	
6	Fuel deliveries, comparative measurement: (Actuator current 0 mA)	Setting point: (cm ^{3} /min)	Max. permis. delivery: (cm ^{3} /min)
	Idle: Part load: Full load:	6,0 40,0 100,0	6,6 42,5 109,0
	Min. delivery at max. air-flow sensor plate defl.:	230 cm ^{3} /min	



p_1 = Primary pressure
p_2 = Lower-chamber pressure



A03 — ⟹

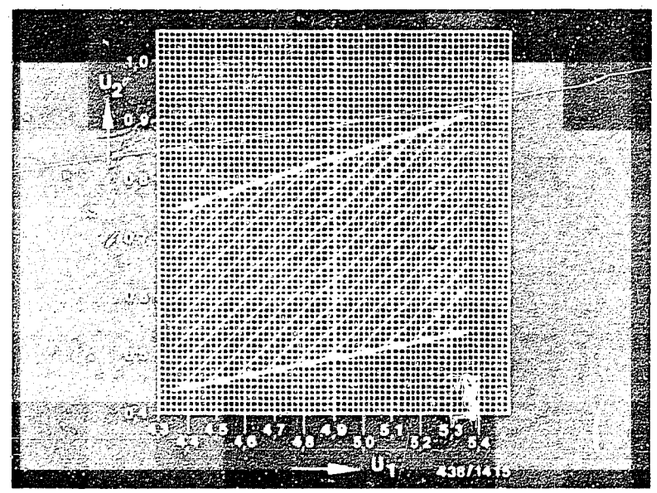
A04 — ⟸⟹

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification
7	Rate of flow, KE restriction:	130...150 cm^3 /min
8	Temperature sensor, air (NTC I): Air temperature +15...+30°C:	 1,3...3,6 k Ω
9	Temperature sensor, engine (NTC II): Engine cold (+15...+30°C): Engine warm (approx. +80°C):	 1,3...3,6 k Ω 250...390 Ω
10	Idle-mixture-adjusting screw basic setting: Fuel-distributor seat - needle bearing:	 20,9...21,6 mm
11	Idle adjustment: Low-idle-speed control: adjustment of idle-air delivery not possible. For testing, engine at norm. op. temp. Idle speed: Engage driving position, speed: Engage driving position and switch on air conditioner, speed: Check lambda closed-loop control: Measurement with lambda closed-loop control tester (e.g. KDJE-P 600) and adapter lead (e.g. KDJE-P 600/52) at diagn. socket outlet (pin3) Alternatively: Current measurement using universal test adapter. Put fuel evaporation system out of operation. On/off ratio fluctuating, mean value: Adjustment at idle-mixture-adjusting screw.	 830...930 min^{-1} 630...730 min^{-1} > 720 min^{-1} 40...60 %

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification
12	Signal, air-flow sensor potentiometer: (Checking necessary when poor idle and/or part-load behavior) Measurement using test adapter and voltmeter. Determine supply voltage of potentiometer: Set value (test adapter, V-position 10): Determine potentiometer signal at idle speed. (Test adapter, V-position 11) Set value corresponding to supply voltage: Adjust signal if necessary at trimming potentiometer (at right next to potentiometer pins). Afterwards, re-secure adjusting screw of trimming potentiometer using black sealing compound (e.g Teroson).	 4,35...5,35 V See chart



U_1 = Supply voltage potentiometer

U_2 = Potentiometer voltage signal

SELF-DIAGNOSIS

All Daimler-Benz models 190 E 2.3-16 with KE 3.1-Jetronic are equipped in the current series with self-diagnosis through on-off-ratio measurement.

Faulty input signals of the KE-Jetronic control unit can be displayed at the lambda test output (diagnostic socket jack 3) with the lambda closed-loop control tester.

Short circuits and open circuits in leads can thus be diagnosed. Sporadic faults (e.g. loose contacts) are not diagnosed. The output of defect information has priority over the output of the lambda closed-loop control signal.

We will not go into the details here of the faults which can be indicated, since the input signals of the KE-Jetronic control unit can be tested with the universal test adapter (rapid diagnosis chart).

However, if during testing of lambda closed-loop control a constant on-off ratio is indicated by means of on-off-ratio measurement, the input signals of the KE-Jetronic control unit should be tested (rapid diagnosis chart).

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER
ETT 018.01 WITH KE3 ADAPTER LEAD
1 684 463 169 AND APPROPRIATE MULTITESTER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic expert to quickly check the electric/electronic peripheral and control-unit functions of the the KE-Jetronic, inlcuding the lambda closed-loop control.

Important note on the rapid diagnosis chart:

The "Test conditions" column gives information as to in which test steps the control-unit plug must be connected/disconnected. Make absolutely certain that there is no current at the system when connecting or disconnecting, i.e. the ignition must be switched off and the electric safety circuit must not be short circuited.

The "Test connections" column provides information about the leads connected to the respective measuring path, referring to the assignment in the control-unit plug. Possibly necessary trouble-shooting is with regard to these leads.

A t t e n t i o n :

When carrying out the test, make sure that the trimming plug is in position 1.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/TA V	Ω	TA	Subject of testing	Test pins	Test requirements	Test specifications
1	V	4	–	Internal resistance (R_i) of pressure actuator	12–10	Disconnect control-unit plug.	20...30 Ω
2	V	5	–	Resistance NTC II (engine)	21– 2	Engine temperature +15...+30°C: approx. +80°C:	1,3...3,6 k Ω 250...390 Ω
3	V	6		Resistance NTC I (intake air)	11– 2	Air temperature in area of NTC I = +15...+30°C:	1,3...3,6 k Ω
4	V	17	–	Altitude-sensor signal	14– 2	Connect control unit. Switch on ignition. Connect voltmeter to blue Ω jacks. Signal altitude-dependent: 0 meters (sea level): 500 meters: 1000 meters: 1500 meters: 2000 meters: 3000 meters:	 3,2...4,5 V 2,8...4,0 V 2,4...3,5 V 2,0...3,0 V 1,5...2,5 V 0,8...1,6 V
5	V	9	–	Throttle-valve switch, idle	13– 2	Switch off ignition. Disconnect control-unit cable plug. Throttle valve open: closed:	 0...10 Ω > 1000 Ω
6	V	10	–	Throttle-valve switch, full load	5– 2	Throttle valve closed: fully open:	infinite Ω 0...10 Ω
7	V	11	–	Microswitch, idle linkage	24– 2	Throttle valve open: closed:	0...10 Ω infinite Ω
8	V	12	–	Ground, control unit	20– 2		0...10 Ω
9	V	13	–	Ground, pin 7	7– 2	Switch off ignition. Connect control unit.	0...10 Ω

Rapid diagnosis chart for universal test adapter ETT 018.01 (continued)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
10	⏐ V	14	–	Trimming plug Mixture map	22– 2	Disconnect control-unit plug. Disconnect lead plug from air-flow sensor potentiometer and connect socket 1 of plug (in upper installation position) to engine ground. Trimming-plug position 1: 2: 3: 4: 5: 6: 7:	 0...10 Ω ——— Ω ——— Ω ——— Ω ——— Ω ——— Ω ——— Ω
11	⏐ V	15	–	Transmission switch (only automatic transmission)	16– 2	Connect air-flow sensor potentiometer. Selection lever position P, N: Driving position selected:	 0...10 Ω infinite Ω
12	5	–	–	TD signal	25– 2	Start engine (starting motor):	Voltage undefined
13	6	–	–	Control-unit supply	1– 2	Switch on ignition:	8...15 V
14	7	–	–	Idle actuator supply and continuity	3– 2	Switch on ignition:	8...15 V
15	8	–	–	Tempomat signal	6– 2	Switch Tempomat operation:	8...15 V
16	9	–	–	Air-conditioner cut-in signal	19– 2	Switch off ignition. Connect control unit. Start engine, switch on air conditioner. Temperature regulator = Minimum temperature	 8...15 V
17	10	–	–	Supply, air-flow sensor potentiometer	18– 2	Switch on ignition:	4,35...5,35 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
18	11	–	–	Signal, air-flow sensor potentiometer	17– 2	Switch on ignition. Air-flow sensor plate in neutral position: Defect air-flow sensor plate by hand, continuous voltage rise up to max.:	0 V 5,35 V
19	13	–	1	Temperature signal form control unit	9– 2	Switch on ignition. While actuating btn 1:	1,5...1,9 V
20	14	–	–	Consumption signal	4– 2	Start engine – idle: With regulation:	Voltage indefined Voltage change
21	–	–	–	Peak coil current	12–12	Switch on ignition:	->FD ——: ——— mA FD 548 ->: 40...70 mA
22	–	–	1	Warm-up enrichment + 20°C	12–12	Warm up engine – idle. Current value with btn 1 pressed:	->FD 642: 20...30 mA FD 643 ->: 16...26 mA
23	–	24	2	Actuator current Engine at norm. op. temp.	12–12	Engine at norm. op. temp., idle. Current value with btn 2 pressed; reading oscillating, mean value:	->FD ——: ——— mA FD 548 ->: –6... +2 mA
24	–	21	1	Starting enrichment	12–12	So that engine fails to start: Disconnect speed relay for electric fuel pump. Short circuit ignition coil term. 4 to ground via resistance of at least 2 k Ω . (e.g. with sleeve-type suppressor and spark gap) While btn 1 pressed, actuate starting motor. Current rise (max. 1 sec.) to:	->FD 642: 60... 90 mA FD 643 ->: 90...120 mA

*) FD = Date of manufacture

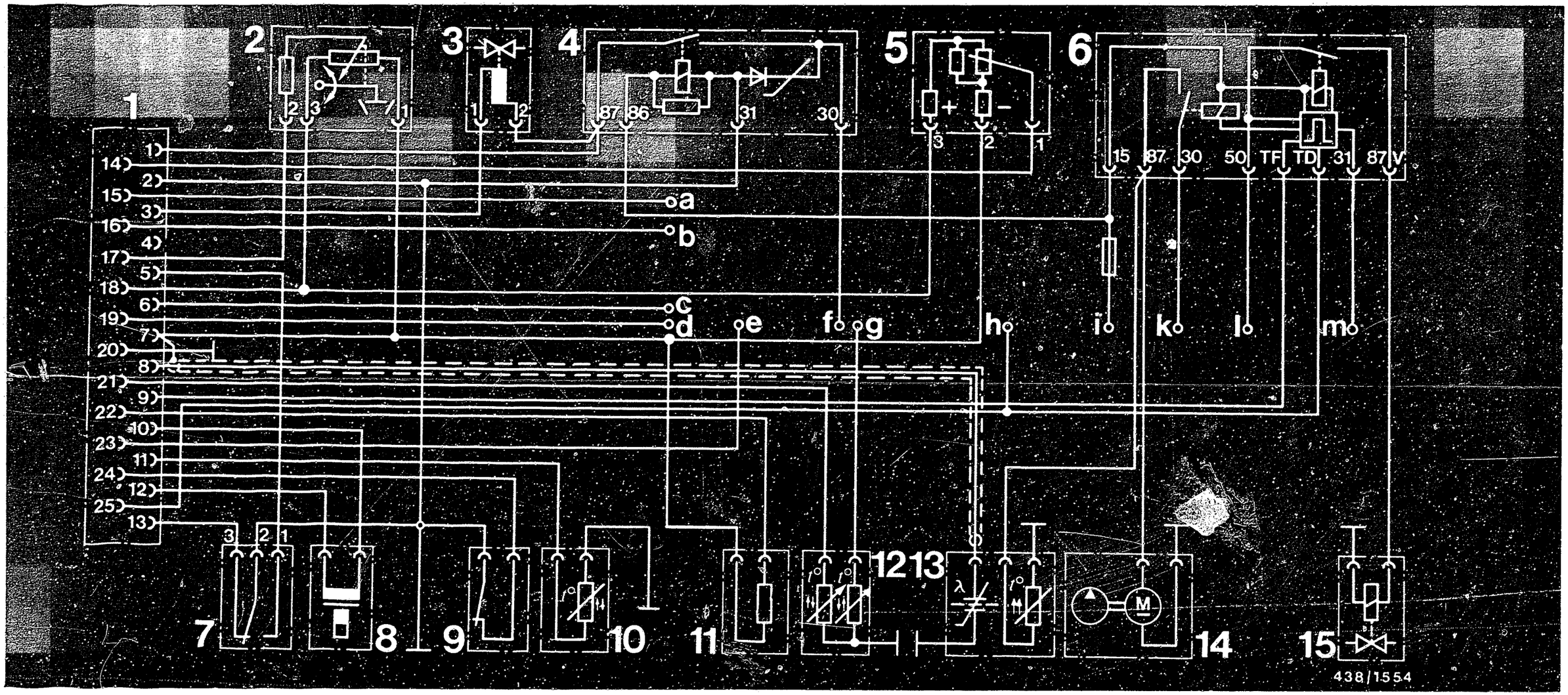
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
25	–	21	1	Post-start enrichment	12-12	Start engine (at normal operating temperature) while actuating btn 1. Current value: Current value constant for approx: Then slow speed regulation to:	 ->FD ——: ——— mA FD 548 ->: 25...35 mA ->FD ——: ——— s FD 548 ->: 1... 3 s ->FD 642: 20...30 mA FD 643 ->: 16...26 mA
26	–	21	1	Acceleration enrichment	12-12	Engine at normal operating temperature, idle. While actuating btn 1, perform snap acceleration of engine. Thus current rise (approx. 1 s) to: Note: Level of current value dependent upon intensity of acceleration (travel/duration of air-flow sensor flap movement).	 ->FD 642: 70...100 mA FD 643 ->: 50... 80 mA
27	–	–	–	Overrun cut-off	12-12	Re-connect ammeter (swap positive and negative) Start engine (normal operating temperature). Speed n to approx.: Hold there. Manually actuate idle throttle-valve switch (for 4- and 6-cyl. engines, microswitch at accelerator linkage). Engine hunts. Current reading during falling speed phase:	 ->FD ——: ——— min^{-1} FD 548 ->: 3000 min^{-1} -40...-80 mA

*) FD = Date of manufacture

No.	Switch/TA V	Ω	TA	Subject of testing	Test pins	Test conditions	Test specifications CAT
28	–	24	–	Full-load enrichment	12-12	Engine at operating temperature, idle. Reading oscillates, median value: Briefly depress accelerator pedal all the way (throttle-valve-switch full-load contact must close). During the rise in engine speed the current value increases by: I m p o r t a n t : This process must be kept very brief, so that the engine speed does not rise excessively and damage the engine.	 ->FD —— : —— mA FD 548-> : -6...+2 mA ->FD 642 : 2... 7 mA FD 643-> : 5...12 mA
29	–	21	–	Lambda closed-loop control, open-loop operation	12-12	Disconnect regeneration line to venturi assembly at the regeneration value, and seal off. Engine at operating temperature, idling. Current value: (*) = manual transmission only)	 FD 548 : -6...-2 mA *) ->FD 642 : -2...+2 mA FD 643-> : -6...-2 mA
30	–	24	–	Lambda closed-loop control, closed-loop operation	12-12	Engine at operating temperature, idling. Closed-loop operation can be recognised by the fluctuating current reading. Median value: (*) = manual transmission only) If median value exceeds tolerances, set (idle-mixture-adjusting screw) to approx.: (*) = manual transmission only)	 FD 548 : -6...-2 mA *) ->FD 642 : -2...+2 mA FD 643-> : -6...-2 mA FD 548 : -4 mA *) ->FD 642 : 0 mA FD 643-> : -4 mA
31	–	22	–	Lambda closed-loop control, rich-mixture stop	12-12	Engine at operating temperature, idling. Current rise to:	10... 15 mA
32	–	23	–	Lambda closed-loop control, lean-mixture stop	12-12	Engine at operating temperature, idling. Current drop to:	-4...-10 mA

FD = date of manufacture

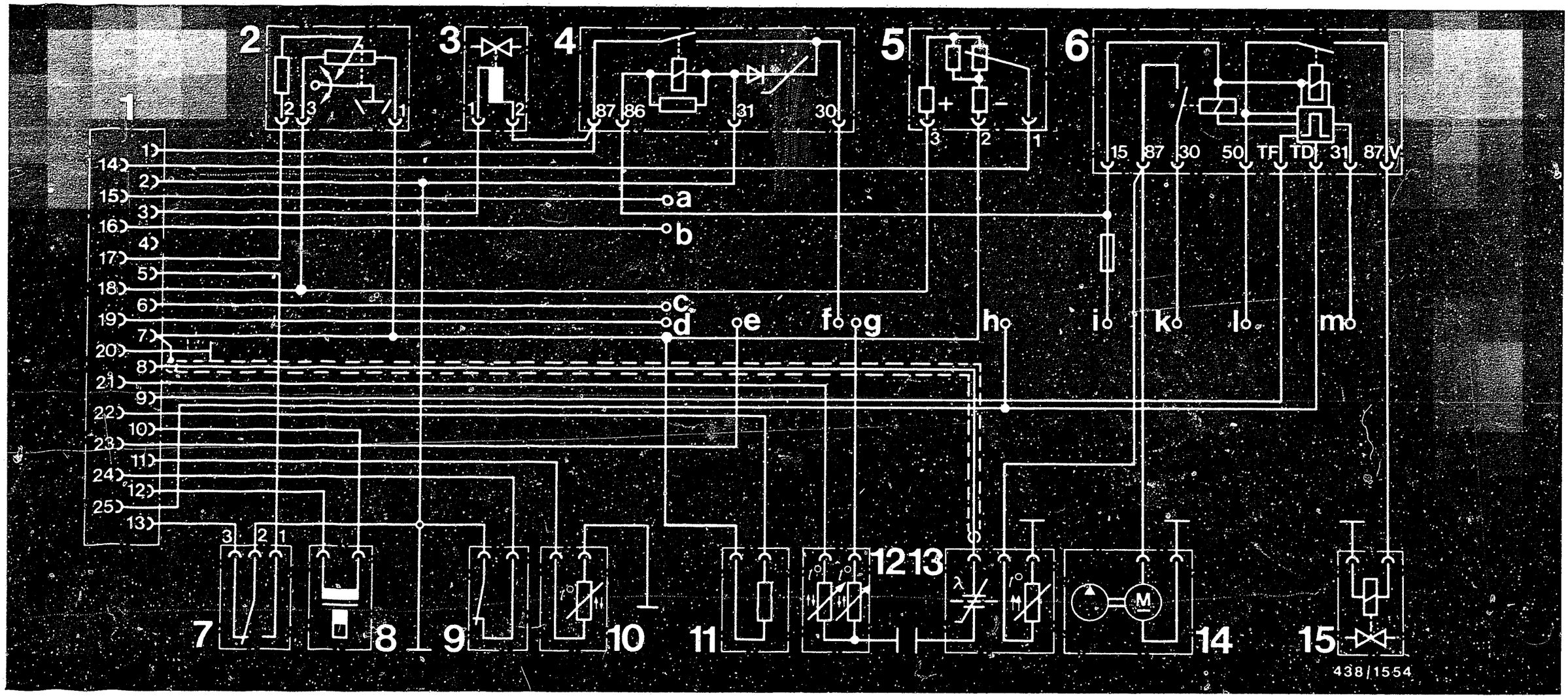


1 = KE-Jetronic control unit
2 = Air-flow sensor potentiometer
3 = Idle actuator
4 = Over-voltage protection relay
5 = Altitude sensor
6 = Electronics relay for actuating electric fuel pump and start valve
7 = Throttle-valve switch, idle/full load
8 = Electro-hydraulic pressure actuator
9 = Throttle-valve switch, idle/linkage
10 = Intake-air temperature sensor
11 = Adjustment resistance, mixture map
12 = Engine-temperature sensor (double NTC)
13 = Heated lambda sensor
14 = Electric fuel pump
15 = Start valve

ELECTRICAL TERMINAL DIAGRAM WITH SAFETY CIRCUIT, ELECTRIC FUEL PUMP

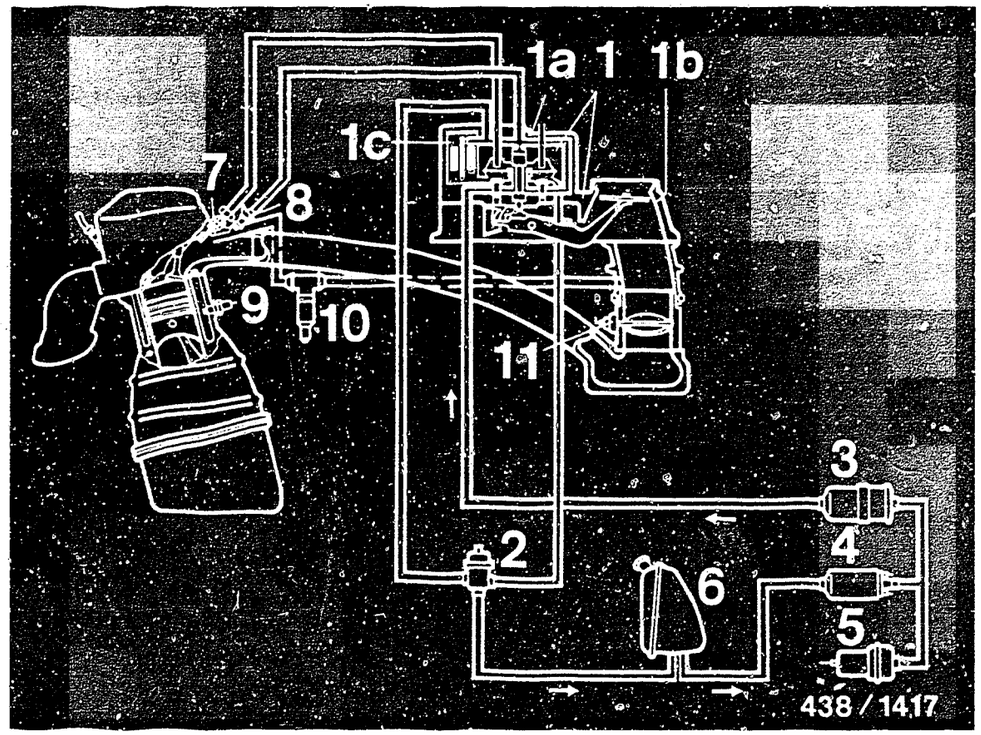
A21 — ⟹

A22 — ⟸



a = Lambda malfunction indicator
b = Transmission switch
c = Connection, Tempomat operating element
d = Connection, air-conditioner control unit
e = Lambda test output (diagnosis socket outlet, socket 3)
f = Terminal 30
g = Ignition system (EI)
h = Terminal TD, ignition
i = Terminal 15
k = Terminal 30
l = Terminal 50
m = Kick-down switch, socket 1

ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC FUEL PUMP SAFETY CIRCUIT (CONTINUATION)



1 = Mixture-control unit
1a = Fuel distributor
1b = Air-flow sensor
1c = Electro-hydraulic pressure actuator
2 = Pressure regulator, primary pressure
3 = Fuel filter
4 = Electric fuel pump
5 = Fuel accumulator
6 = Fuel tank
7 = Injection valve
8 = Cold-start valve
9 = Temperature sensor engine (Double NTC)
10 = Idle actuator
11 = Throttle-valve switch, idle/full load

DIAGRAM OF AIR AND FUEL LINES

INSTALLATION POSTION OF COMPONENTS

* KE-Jetronic control unit,
  Elektronics relay for actuation of
  electric fuel pump and start valve,
  over-voltage protection relay,
  altitude sensor (pressure sensor):
  In equipment compartment on right, behind the battery.

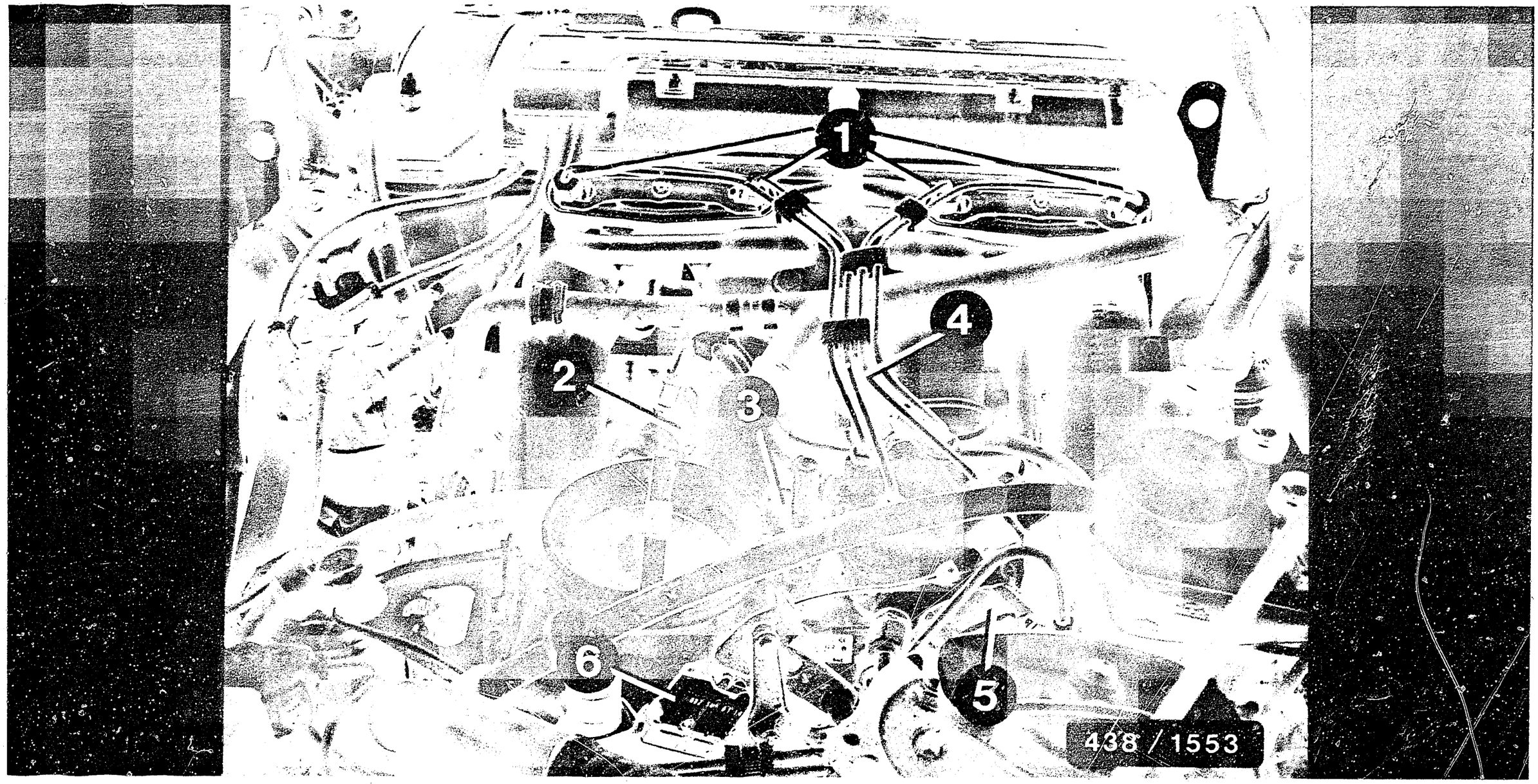
* Idle actuator:
  Underneath intake manifold 3.

* Throttle-valve switch idle/full load:
  On venturi assembly, throttle shaft.

* Temperature sensor, engine (NTC II):
  On cylinder head, front (double connection).

* Temperature sensor, intake air (NTC I):
  On lower section of air filter, to the rear.

* Electric fuel pump, fuel accumulator,
  fuel filter:
  On common support on vehicle floor, on left in
  area in front of rear axle.



1 = Fuel-injection valves
2 = Pressure regulator
3 = Mixture-control unit
4 = Start valve (covered)
5 = Pressure actuator
6 = Throttle-valve switch, idle/linkage

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

T A B L E O F C O N T E N T S

Trouble-shooting instructions : MB-5018

BOSCH system : KE 3.1-Jetronic

Vehicle make : MERCEDES-BENZ

Basic microcard : PKW-C14

Tests without coordinate references are not included in these trouble-shooting instructions.

SPECIAL FEATURES

* These instructions contain the trouble-shooting instructions, valid at the time of publication, for the following model:

  MERCEDES-BENZ
  190 E 2.3-16, 2,3 l / 4Zyl. 08.85->

* Trouble-shooting with theses instructions may only then take place when the details of the "Summary - Service Information for Vehicles" (KFZ-0..) coincide with those of the vehicle type and with the BOSCH number of the KE-Jetronic control unit installed.

* Control unit using digital techniques, characteristic-map control using microprocessor.

* Multi-functional fuel-management system with a characteristic map for operation with lambda closed-loop control (CAT) and a characteristic map for operation without lambda closed-loop control (ECE). Activation of the characteristic maps by trimming plug with corresponding marking. To set to the fuel grades unleaded regular and unleaded premium, only the ignition trimming plug must be re-connected.

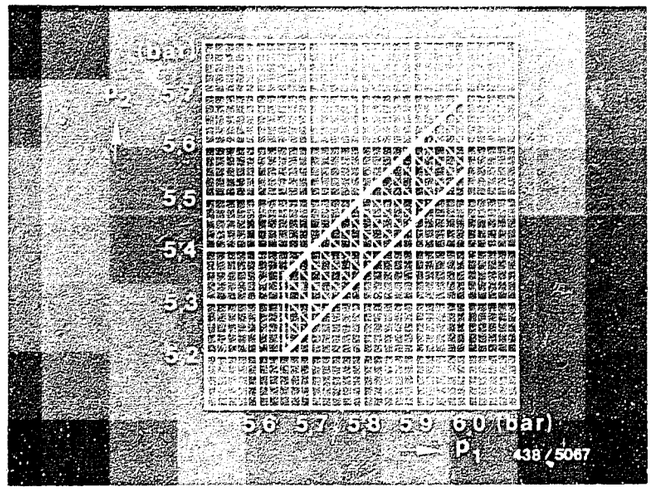
* Electronically controlled idle-speed control with single-winding rotary actuator, without bypass adjusting screw.

* Activated-carbon filter and regeneration valve for return of gasoline vapors into the intake manifold. (Fuel evaporation system)

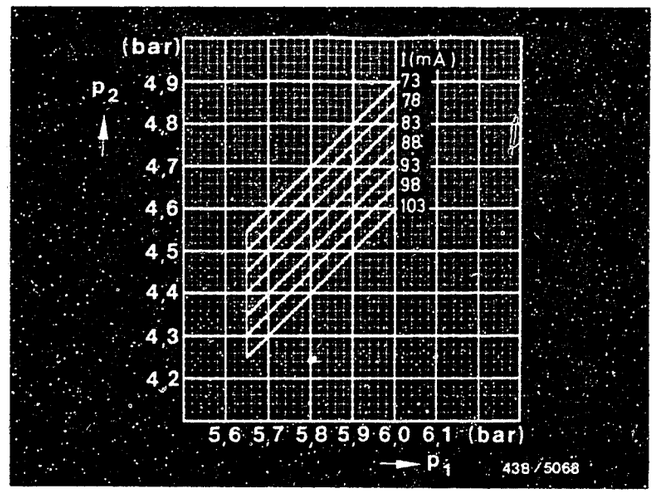
Important note:
If reference is made to a basic microcard, always make certain you use the test specifications from the vehicle-specific brief instructions.

TEST SPECIFICATIONS

No.	Testing/Test condition	Test specification	
1	Electric fuel pump – fuel delivery:	At least 1350 cm ^{3} /min	
2	Primary pressure:	5,65...6,0 bar	
3	Differential pressure: Suppression of peak coil current: Actuate starting motor with fuel-pump relay disconnected. Do not switch off ignition after starting. Take lower-chamber pressure set value "warm" from top chart corresponding to primary pressure measured. (Actuator current 0 mA) Take lower-chamber pressure set value "cold" from bottom chart corresponding to primary pressure measured and actuator current. Tolerance ± 0.15 bar. Simulation of "cold" state: press push-button 3 at test adapter.		
4	Leakage test, complete system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 2,7 bar 2,6 bar	
5	Injection valves, opening pressure:	3,0...4,1 bar	
6	Fuel deliveries, comparative measurement: (Actuator current 0 mA) Idle: Part load: Full load: Min. delivery at max. air-flow sensor plate defl.:	Setting point: (cm ^{3} /min) 6,0 40,0 100,0 230 cm ^{3} /min	Max. permis. delivery: (cm ^{3} /min) 6,6 42,5 109,0



p_1 = Primary pressure
p_2 = Lower-chamber pressure

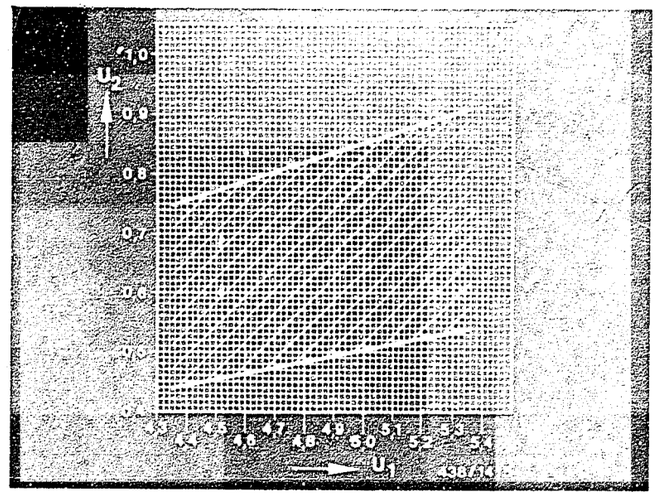


TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification
7	Rate of flow, KE restriction:	130...150 cm^3 /min
8	Temperature sensor, air (NTC I): Air temperature +15...+30°C:	 1,3...3,6 k Ω
9	Temperature sensor, engine (NTC II): Engine cold (+15...+30°C): Engine warm (approx. +80°C):	 1,3...3,6 k Ω 250...390 Ω
10	Idle-mixture-adjusting screw basic setting: Fuel-distributor seat - needle bearing:	 20,9...21,6 mm
11	Idle adjustment: Low-idle-speed control: adjustment of idle-air delivery not possible. For testing, engine at norm. op. temp. Idle speed: Engage driving position, speed: Engage driving position and switch on air conditioner, speed: Only ECE: CO concentration in exhaust gas: Only CAT: Check lambda closed-loop control: Measurement with lambda closed-loop control tester (e.g. KDJE-P 600) and adapter lead (e.g. KDJE-P 600/52) at diag. socket outlet (pin3). Alternatively: Current measurement using universal test adapter. Put fuel evaporation system out of operation. On-off ratio fluctuating, mean value: Adjustment at idle-mixture-adjusting screw.	 850...950 min^{-1} 630...730 min^{-1} > 720 min^{-1} 0,5...1,5 % CO by vol. 40...60 %

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Test specification
12	Signal, air-flow sensor potentiometer: (Checking necessary when poor idle and/or part-load behavior) Measurement using test adapter and voltmeter. Determine supply voltage of potentiometer: Set value (test adapter, V-position 10): Determine potentiometer signal at idle speed. (Test adapter, V-position 11) Set value corresponding to supply voltage: Adjust signal if necessary at trimming potentiometer (at right next to potentiometer pins). Afterwards, re-secure adjusting screw of trimming potentiometer using black sealing compound (e.g Teroson).	 4,35...5,35 V See chart



U_1 = Supply voltage potentiometer

U_2 = Potentiometer voltage signal

SELF-DIAGNOSIS

All Daimler-Benz models 190 E 2.3-16 with KE 3.1-Jetronic are equipped in the current series with self-diagnosis through on-off-ratio measurement.

Faulty input signals of the KE-Jetronic control unit can be displayed at the lambda test output (diagnostic socket jack 3) with the lambda closed-loop control tester.

Short circuits and open circuits in leads can thus be diagnosed. Sporadic faults (e.g. loose contacts) are not diagnosed. The output of defect information has priority over the output of the lambda closed-loop control signal.

We will not go into the details here of the faults which can be indicated, since the input signals of the KE-Jetronic control unit can be tested with the universal test adapter (rapid diagnosis chart).

However, if during testing of lambda closed-loop control a constant on-off ratio is indicated by means of on-off-ratio measurement, the input signals of the KE-Jetronic control unit should be tested (rapid diagnosis chart).

RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER ETT 018.01 WITH KE3 ADAPTER LEAD 1 684 463 169 AND APPROPRIATE MULTITESTER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic expert to quickly check the electric/electronic peripheral and control-unit functions of the KE-Jetronic, including the lambda closed-loop control.

Important note on the rapid diagnosis chart:

The "Test conditions" column gives information as to in which test steps the control-unit plug must be connected/disconnected. Make absolutely certain that there is no current at the system when connecting or disconnecting, i.e. the ignition must be switched off and the electric safety circuit must not be short circuited.

The "Test connections" column provides information about the leads connected to the respective measuring path, referring to the assignment in the control-unit plug. Possibly necessary trouble-shooting is with regard to these leads.

The "Test specifications" column contains the test specifications for both the version without lambda closed-loop control (ECE, left-hand test-specifications column) and for the version with lambda closed-loop control (CAT, right-hand test-specifications column). Before starting testing, determine which version is being tested. If only one test specification is given, this applies to both versions.

Attention: When carrying out the test, make sure that the trimming plug is in position 1.

RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUATION)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications
1	V	4	–	Int. resistance(R_i) pressure actuator	12–10	Disconnect control-unit lead plug.	20...30 Ω
2	V	5	–	Resistor NTC II (engine)	21– 2	Engine temperature +15°...+30° C: approx. +80° C :	1,3...3,6 k Ω 250...390 Ω
3	V	6	–	Resistor NTC I (intake air)	11– 2	Air temperature in area of NTC I: +15°...+30° C:	1,3...3,6 k Ω
4				Signal, altitude sensor		Connect control unit. Switch on ignition. Voltmeter connection to blue Ω sockets. Signal altitude-dependent: 0 Meters (sea level): 500 Meters: 1000 Meters: 1500 Meters: 2000 Meters: 3000 Meters:	Test step not applicable!
5	V	9	–	Throttle-valve switch, idle	13– 2	Switch off ignition. Disconnect control-unit lead plug. Throttle valve closed: open:	 0...10 Ω > 1000 Ω
6	V	10	–	Throttle-valve switch, full load	5– 2	Throttle valve closed: fully open:	Infinite Ω 0...10 Ω
7	V	11	–	Microswitch idle linkage	24– 2	Throttle valve closed: open:	0...10 Ω Infinite Ω
8	V	12	–	Ground, control unit	20– 2		0...10 Ω
9	V	13	–	Ground, pin 7	7– 2	Switch off ignition. Connect control unit.	0...10 Ω

RAPID DAIGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications ECE	CAT
10	| V	14	–	Trimming plug mixture map	22– 2	Disconnect control-unit lead plug. Disconnect lead plug from air-flow sensor potentiometer and connect socket 1 of plug (in upper installation position) with engine ground.		
						Trimming-plug position 1:	50... 60 Ω	900... 1050 Ω
						2:	100... 120 Ω	1200... 1350 Ω
						3:	150... 190 Ω	1500... 1750 Ω
						4:	230... 270 Ω	2000... 2400 Ω
						5:	330... 370 Ω	3000... 3600 Ω
						6:	430... 470 Ω	5000... 5600 Ω
						7:	570... 620 Ω	11000...12000 Ω
11	| V	15	–	Transmission switch (only automatic transmission)	16– 2	Connect air-flow sensor potentiometer. Selection lever in position P, N:	0...10 Ω	
						Driving position selected:	Infinite Ω	
12	5	–	–	TD signal	25– 2	Start engine (starting motor):	Voltage indefined	
13	6	–	–	Control-unit supply	1– 2	Switch on ignition:	8...15 V	
14	7	–	–	Idle actuator supply and continuity	3– 2	Switch on ignition:	8...15 V	
15	8	–	–	Tempomat signal	6– 2	Switch Tempomat operation:	8...15 V	
16	9	–	–	Air-conditioner cut-in signal	19– 2	Connect control unit. Start engine, switch on air conditioner. Temperature regulator = minimum temperature:	8...15 V	
17	10	–	–	Supply, air-flow sensor potentiometer	18– 2	Switch on ignition:	4,35...5,35 V	

B13 —— <⟹>

B14 —— <⟹>

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specificatons ECE	CAT
18	11	–	–	Signal, air–flow sensor potentiometer	17– 2	Switch on ignition. Air–flow sensor plate in neutral position: Deflect air–flow sensor plate by hand, continuous voltage rise up to max.:	0 V 5,35 V	
19	13	–	1	Temperature signal from control unit	9– 2	Switch on ignition. While actuating btn 1:	1,5...1,9 V	
20	14	–	–	Consumption signal	4– 2	Start engine – idle: With regulation:	Voltage indefined Voltage change	
21	–	–	–	Peak coil current	12–12	Switch on ignition:	–>FD —— : ——— mA FD 548–>: 60...90 mA	–>FD —— : ——— mA FD 548–>: 40...70 mA
22	–	–	1	Warm–up enrichment +20°C	12–12	Warm up engine – idle. Current value with btn 1 pressed:	–>FD —— : ——— mA FD 548–>: 10...20 mA	–>FD —— : ——— mA FD 548–>: 20...30 mA
23	–	24	2	Actuator current Engine at norm. op. temp.	12–12	Eng. at norm. op. temp., idle Current valve with btn 2 pressed: With CAT, oscillating, mean value:	–>FD —— : ——— mA FD 548–>: –4...+7 mA	–>FD —— : ——— mA FD 548–>: –1...+1 mA
24	–	21	1	Starting enrichment	12–12	So that eng. fails to start: Disconnect speed relay for elec. fuel pump. Short circuit ign. coil term.4 to grnd via resist. of at least 2k Ω (E.g. with sleeve–type suppressor and spark gap) While btn 1 pressed, actuate starting motor. Current rise (max. 1 s.) to:	–>FD —— : ——— mA FD 548–>: 90...130 mA	–>FD —— : ——— mA FD 548–>: 60...100 mA

FD = Date of manufacture

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

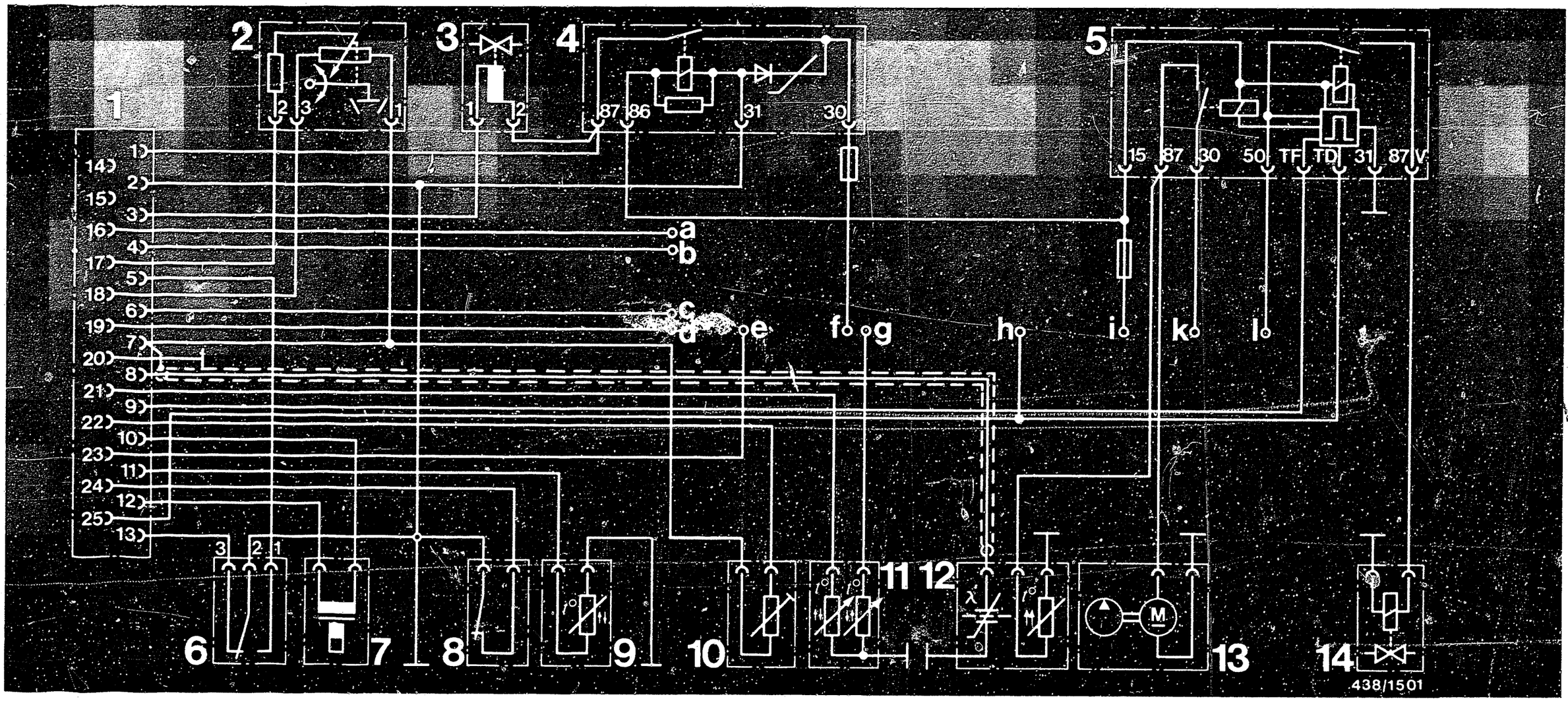
No.	Switch/Btn V	Switch/Btn Ω	Switch/Btn Btn	Under test	Test pins	Test conditions	Test specifications ECE		Test specifications CAT	
25	–	21	1	Post-start enrichment	12-12	Start engine (at normal op. temp.) while actuating btn 1. Current value:	->FD —— :	—— mA	->FD —— :	—— mA
							FD 548->:	18...30 mA	FD 548->:	25...40 mA
						Current value const. for app.	->FD —— :	—— s	->FD —— :	—— s
							FD 548->:	0... 2 s	FD 548->:	0... 3 s
						Then slow speed reg. to:	->FD —— :	—— mA	->FD —— :	—— mA
							FD 548->:	10...20 mA	FD 548->:	20...30 mA
26	–	21	1	Acceleration enrichment	12-12	Eng. at norm. op. temp., idle While actuating btn 1, perform snap acceleration of eng Thus current rise (approx. 1 s) to:	->FD —— :	—— mA	->FD —— :	—— mA
							FD 548->:	30... 60 mA	FD 548->:	60...100 mA
						Note: Level of current value dependent upon intensity of acceleration (travel/ duration of air-flow sensor plate movement).				
27	–	–	–	Overrun cut-off	12-12	Re-connect ohmmeter (swap positive and negative). Start eng. (norm. op. temp.). Speed n to approx.:	->FD —— :	—— min $^{-1}$	->FD —— :	—— min $^{-1}$
							FD 548->:	2000 min $^{-1}$	FD 548->:	3000 min $^{-1}$
						Hold there. Manually actuate idle throttle-valve switch (for 4- and 6- cyl. eng. microswitch at accelerator linkage). Engine hunts. Current reading during falling speed phase:		-40...-80 mA		-40...-80 mA

FD = Date of manufacture

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/Btn V	Ω	Btn	Under test	Test pins	Test conditions	Test specifications ECE	CAT
28	–	24	–	Full-load enrichment	12-12	Eng. at norm. op. temp., idle Current value (ECE): With CAT, oscil., mean value: Briefly push accelerator pedal to floor (full-load throttle-valve switch must switch). During speed rise, current value rises by: <u>Attention</u>: Do this very briefly, so that speed does not rise too much and engine is not damaged.	->FD —— : ——— mA FD 548->: -4...+7 mA ->FD —— : ——— mA FD 548->: 4... 9 mA	->FD —— : ——— mA FD 548->: -1...+1 mA ->FD —— : ——— mA FD 548->: 3... 7 mA
29	–	21	–	Lambda closed-loop control, open-loop control mode	12-12	Disconnect regeneration lead to throttle-valve assembly at regeneration valve and seal. Eng. at norm. op. temp., idle Current value:	——	-1...+1 mA
30	–	24	–	Lambda closed-loop control, closed-loop control mode	12-12	Eng. at norm. op. temp., idle Closed-loop control mode can be recognized from the oscillating current reading. Mean value: If mean value outside tolerance, set (idle-mixture-adjusting screw) to:	—— ——	-1...+1 mA approx. 0 mA
31	–	22	–	Lambda closed-loop control, rich stop	12-12	Eng. at norm. op. temp., idle Current rise to:	——	11...15 mA
32	–	23	–	Lambda closed-loop control, lean stop	12-12	Eng. at norm. op. temp., idle Current drop to:	——	-3...-6 mA

FD = Date of manufacture

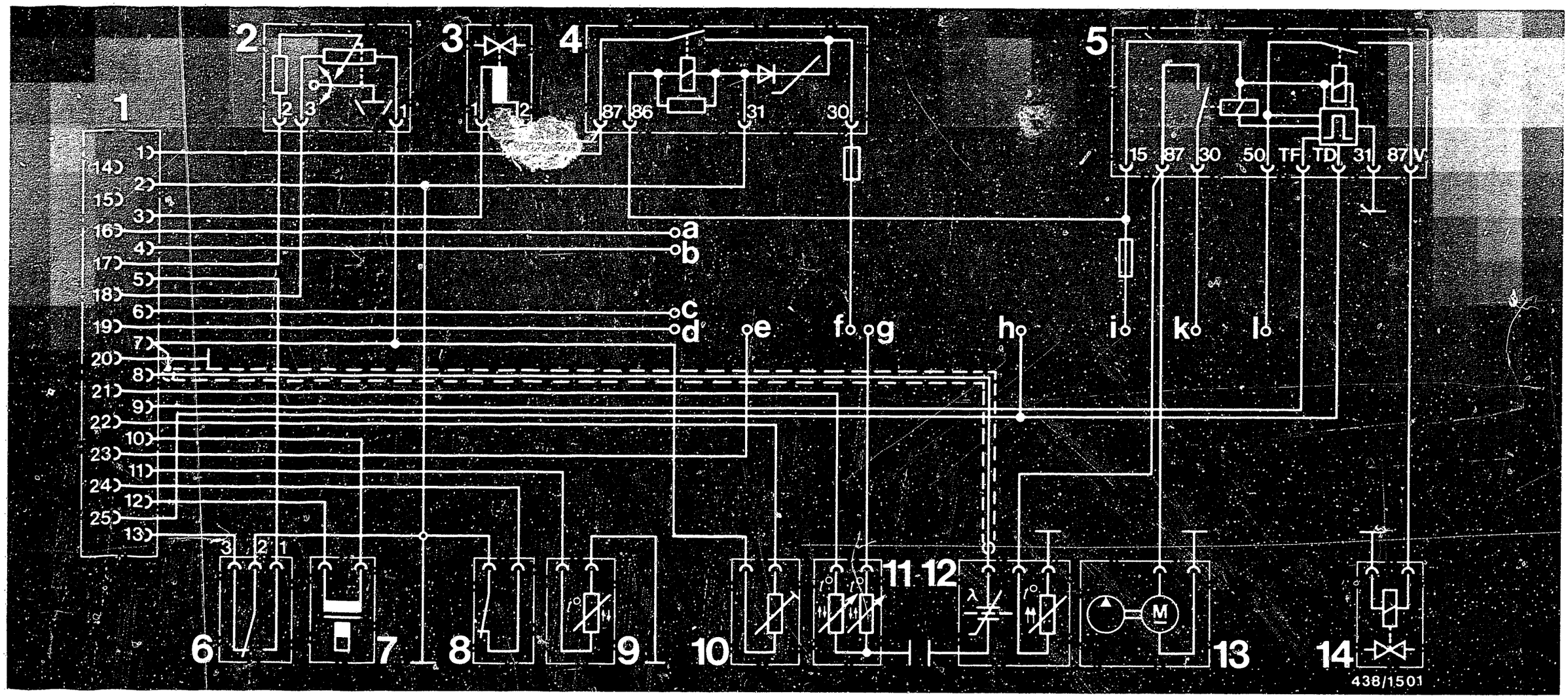


1 = Control-unit, KE-Jetronic
2 = Air-flow sensor potentiometer
3 = Idle actuator
4 = Over-voltage protection relay
5 = Electronic relay for electric fuel pump and cold-start valve actuation
6 = Throttle-valve switch, idle/full load
7 = Electro-hydraulic pressure actuator
8 = Throttle-valve switch, idle/linkage
9 = Temperature sensor, intake air (NTC I)
10 = Trimming plug, map adjustment
11 = Temperature sensor, engine (Double NTC)
12 = Heated lambda sensor
13 = Electric fuel pump
14 = Cold-start valve

ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC FUEL PUMP SAFETY CIRCUIT

B21 ⟹

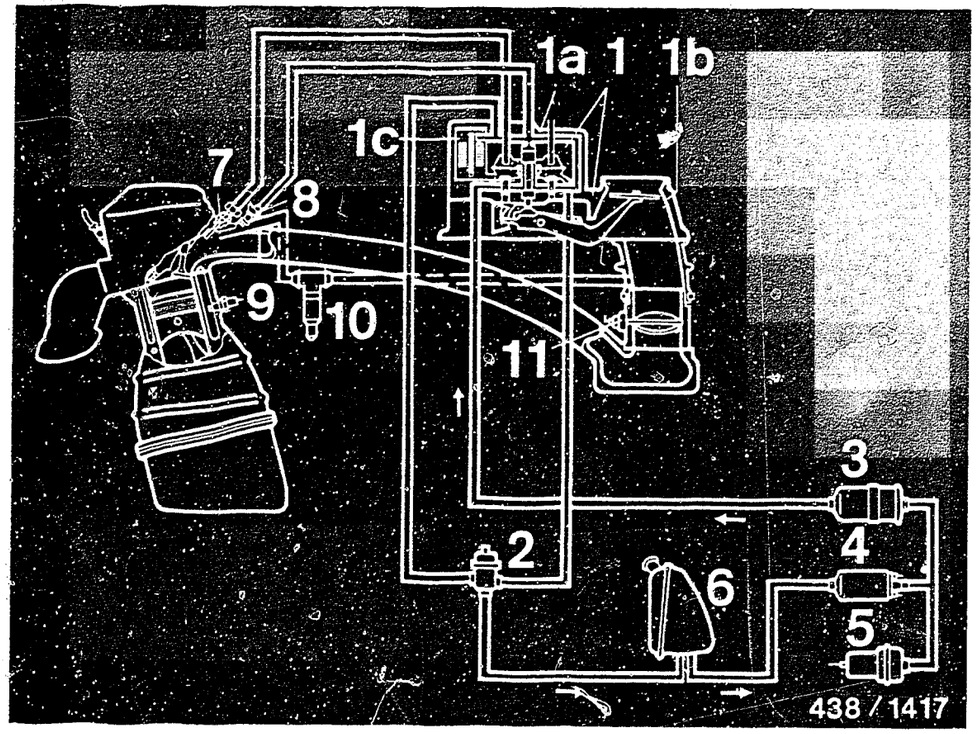
B22 ⟺



a = Transmission switch (only Automatic)
b = Consumption signal
c = Connection of Tempomat operating element
d = Connection of air-conditioner control unit
e = Lambda test output

f = Terminal 30 (B +)
g = Ignition system (EI-L)
h = TD signal, ignition
i = Terminal 15
k = Terminal 30 (B +)
l = Terminal 15a - starting motor

ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC FUEL PUMP SAFETY CIRCUIT (CONTINUED)



1 = Mixture-control unit
1a = Fuel distributor
1b = Air-flow sensor
1c = Electro-hydraulic pressure actuator
2 = Pressure regulator, primary pressure
3 = Fuel filter
4 = Electric fuel pump
5 = Fuel accumulator
6 = Fuel tank
7 = Injection valve
8 = Cold-start valve
9 = Temperature sensor engine (Double NTC)
10 = Idle actuator
11 = Throttle-valve switch, idle/full load

DIAGRAM OF AIR AND FUEL LINES

INSTALLATION POSITION OF COMPONENTS

* KE-Jetronic control unit,
  electronics relay for actuation of electric fuel pump and start valve, over-voltage protection relay, mixture-map adjustment plug:
  In equipment compartment on right, behind the battery.

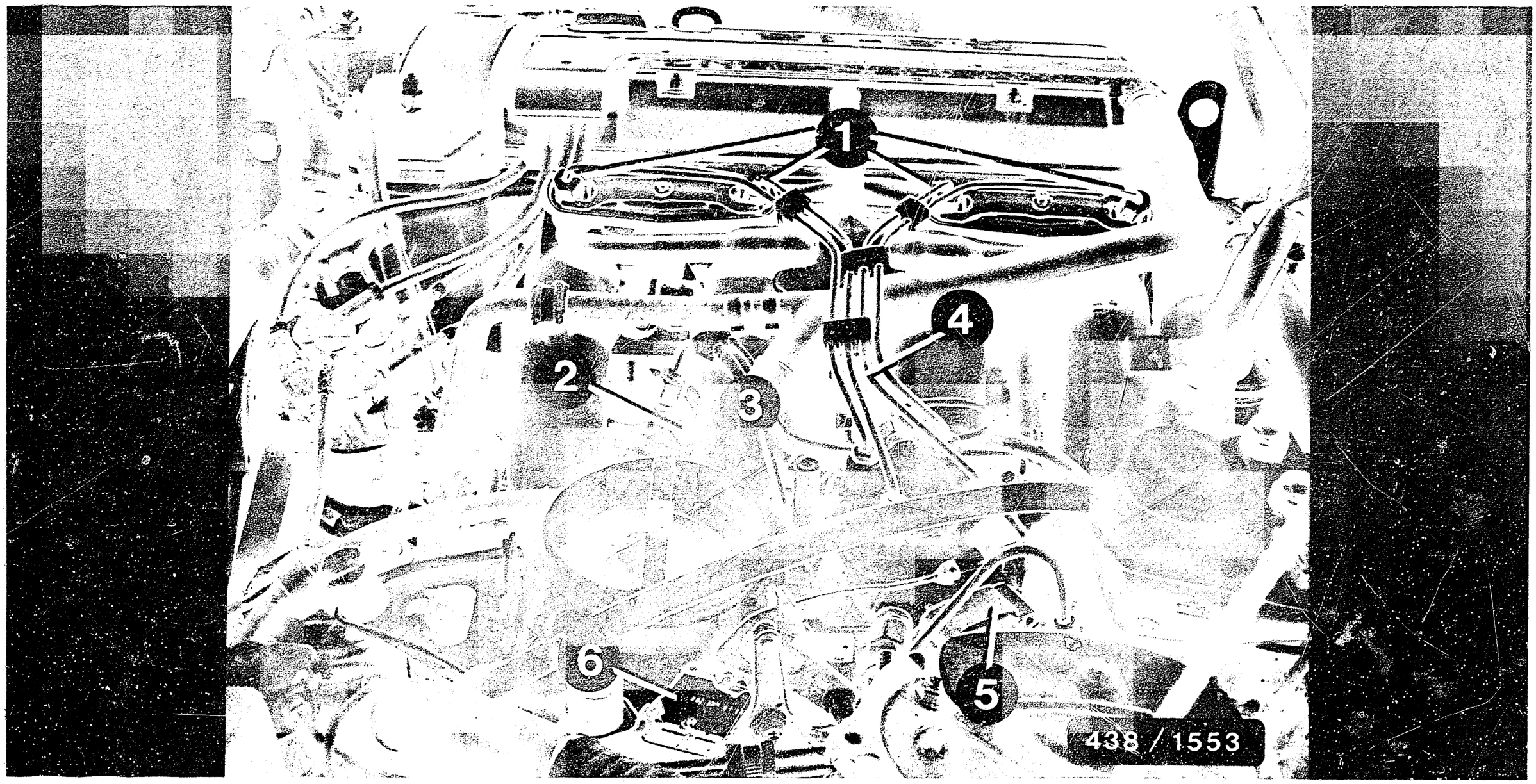
* Idle actuator:
  Underneath intake manifold 3.

* Throttle-valve switch, idle/full load:
  On venturi tube, throttle shaft.

* Temperature sensor, engine (NTC II):
  On cylinder head, forward (double connection).

* Temperature sensor, intake air (NTC I):
  On lower section of air filter, to the rear.

* Electric fuel pump, fuel accumulator, fuel filter:
  On common support on vehicle floor, on left in area in front of rear axle.



1 = Fuel-injection valves
2 = Pressure regulator
3 = Mixture-control unit
4 = Start valve (covered)
5 = Pressure actuator
6 = Throttle-valve switch, idle/linkage

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

T A B L E O F C O N T E N T S

Trouble-shooting instructions	: MB-5019
BOSCH system	: Automatic air conditioner
Make of vehicle	: MERCEDES-BENZ
Basic microcard	: MB-515

Tests without coordinate details are not applicable in the trouble-shooting instructions.

SPECIAL FEATURES

Using these instructions, Mercedes-Benz passenger cars of Type W 126 with electronic automatic air conditioner with blower control, fitted as special equipment as of 09.85, may be tested.
The system has basically the same design as in Type W 124.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER

The following rapid diagnosis chart makes it possible for the experienced expert to quickly check the system using the universal test adapter in connection with the adapter lead KDHK 0010.
The contents of this list are limited to the following details:

* Test step sequence
* Switch position at universal test adapter
* Test instructions
* Information on coordinates of the respective detailed test program and trouble-shooting program.

Test requirement:
* Check customer complaints (check operation of automatic air conditioner in accordance with vehicle owner's manual)
* Coolant level correct
* Refrigerant level correct
* Electrical system (fuses, battery voltage) O.K.
* Temperature thumbwheel in center position (22 °)
* No push-button at operating element pressed.
* Auxiliary heater "OFF", if installed

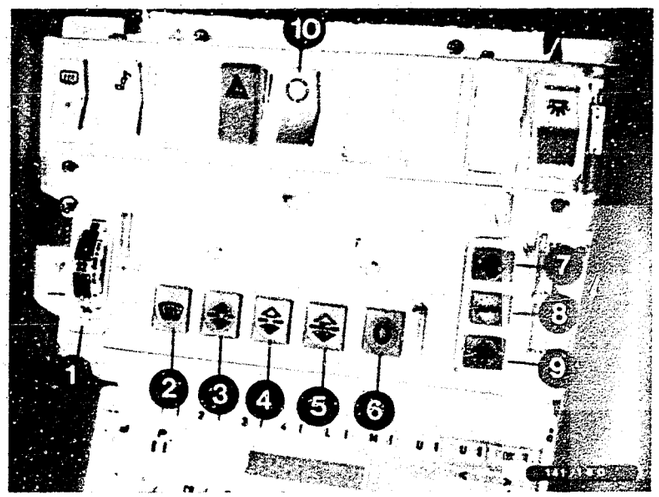
When disconnecting plug connections, the ignition must be switched off.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER (ETT 008.01) with Adapter lead KDHK 0010

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)
1	V	1	Resistance measurement, coolant temperature sensor	120...30 Ω at approx. +20°C...+85°C at coolant temperature sensor
2	V	2	Resistance measurement, interior temperature sensor	approx. 16...6,4 k Ω at approx. +15°C...+35°C at interior temp. sensor
3	V	2	Spray refrigerant spray into interior temperature sensor.	Resistance value must increase during cooling off.
4	V	5	Resistance measurement, evaporator temperature sensor	approx. 20...6,5 k Ω at approx. +10°C...+35°C at temperature sensor
5	V	9	Resistance measurement, discharge temperature sensor	approx. 16...6,4 k Ω at approx. +15°C...+35°C at temperature sensor
6	V	10	Resistance measurement, ambient temperature sensor	approx. 7...2,7 k Ω at approx. + 5°C...+25°C at ambient temperature sensor
Make bridge, socket 1/socket 2 at universal test adapter; connect control unit				
7	1	10	Voltage at coolant temperature sensor Switch on ignition	approx. 6,5...2,0 V at approx. +20°C...+90° C at coolant temperature sensor
8	2	10	Voltage at interior temperature sensor	approx. 3...2 V at approx. +15°C...+35° C at temperature sensor
8.1	2	10	Ventilation of interior temperature sensor Hold strip of paper in front of interior temperature opening	Strip off paper moves towards opening
9	3	10	Supply voltage, electronic control unit	> 10 V

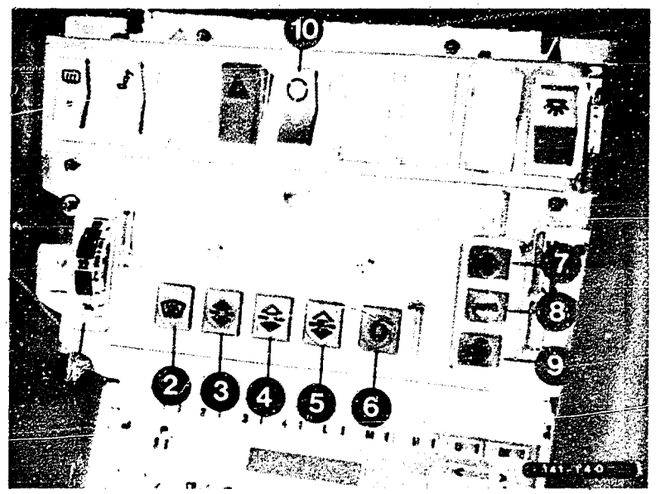
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER (CONTINUED)

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)
10	4	10	Auxiliary heater Auxiliary heater switch on Wait till adjusted	> 10 V
11	8	10	Voltage at ambient temperature sensor	approx. 2,5...3,6 V at approx. +25°C...+ 5°C at temperature sensor
12	9	10	Voltage at discharge temperature sensor	approx. 1,4...3,0 V at approx. +35°C...+16°C at temperature sensor
12.1	9	10	Disconnect bridge, socket 1/socket 2 at universal test adapter. Start engine; engine running and at norm. op. temp. Press blower push-button "Max".	Value must fall
13	10	10	Re-make bridge, socket 1/socket 2 at universal test adapter. Voltage at evaporator temperature sensor.	approx. 2...3 V at approx. +35°C...+10°C at temperature sensor
13.1	10	10	Press push-button "AC" at operating element. Temperature thumbwheel latched in "Min" position	Value must rise
14	12	10	Speed signal Move vehicle very slowly.	Reading fluctuates between approx. 0 V and > 6 V
15	13	10	Fresh-air/ventilation-valve actution Press push-button "EC" at operating element.	> 10 V



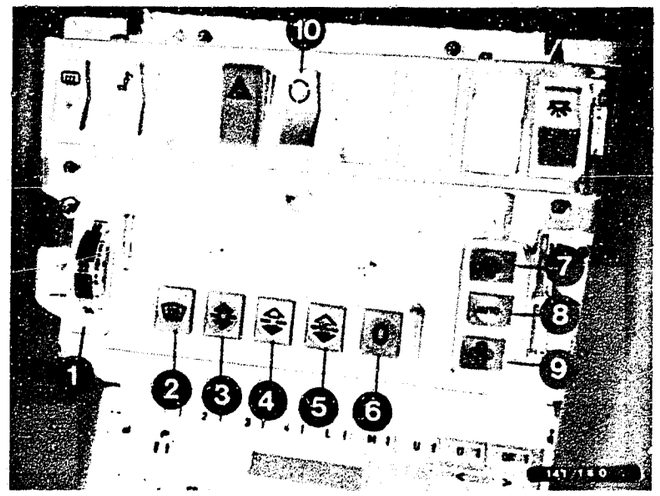
1 = Temperature thumbwheel
2 = Push-button "DEF"
3 = Push-button "BI-LEV"
4 = Push-button "AC"
5 = Push-button "EC"
6 = Push-button "O"
7 = Push-button, blower stage "Max"
8 = Push-button, blower stage "AUTO"
9 = Push-button, blower stage "Min"
10 = Fresh-air/ventilation switch

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)
15.1	13	10	Switch fresh-air/ventilation switch to ventilation position (LED lights).	< 2 V
16	14	10	Fresh-air/ventilation actuation.	< 2 V
			Press push-button "DEF" at operating element.	> 10 V
17	15	10	Center-nozzle valve actuation.	> 10 V
			Turn temperature thumbwheel until latched in "Min" position. Press push-button "AC" at operating element.	< 2 V
18	16	10	Footwell-nozzle valve actuation.	> 10 V
			Press push-button "BI-LEV" at operating element.	< 2 V
19	17	10	Air-renewal flap valve actuation: Press push-button T6 at universal test adapter (simulated high ambient temperature).	< 2 V
			Press push-button "DEF" at operating element	> 10 V
20	18	10	Defroster-nozzle valve actuation.	> 10 V
			Press push-button "AC" at operating element.	< 2 V



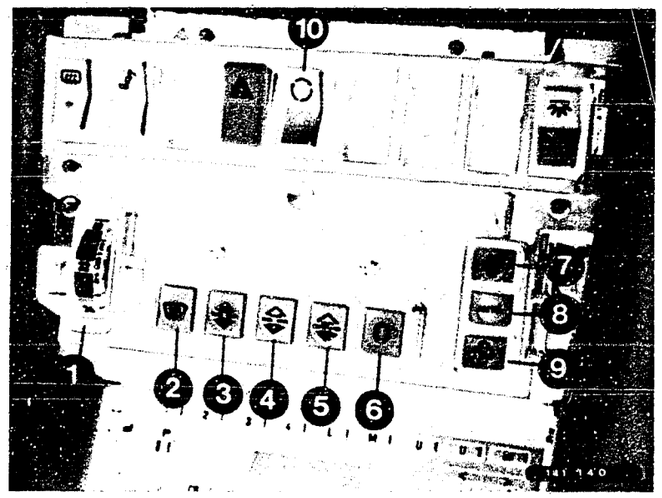
1 = Temperature thumbwheel
2 = Push-button "DEF"
3 = Push-button "BI-LEV"
4 = Push-button "AC"
5 = Push-button "EC"
6 = Push-button "O"
7 = Push-button, blower stage "Max"
8 = Push-button, blower stage "AUTO"
9 = Push-button, blower stage "Min"
10 = Fresh-air/ventilation switch

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)
21	19	10	Compressor coupling actuation: Press push-button "EC" at operating element.	> 10 V
			Press push-button "AC" at operating element.	< 2 V
21.1	19	10	Press push-button T1 at universal test adapter (icing protection simulation).	> 10 V Refrigerant compressor must switch off
21.2	19	10	Press push-button T4 at universal test adapter (engine temperature simulation > 120°C) Refrigerant-compressor emergency cut-off.	> 10 V
22	20	10	Defroster-nozzle valve actuation: Press push-button "DEF" at operating element.	> 10 V
			Press push-button "AC" at operating element.	< 2 V
23	21	10	Heating-water pump actuation: Turn temperature thumbwheel until latched in "Max" position (wait till adjusted).	< 2 V Determine whether heating-water pump running by feeling.
23.1	21	10	Turn temperature thumbwheel until latched in "Min" position.	> 10 V Determine whether heating-water pump running by feeling.



1 = Temperature thumbwheel
2 = Push-button "DEF"
3 = Push-button "BI-LEV"
4 = Push-button "AC"
5 = Push-button "EC"
6 = Push-button "O"
7 = Push-button, blower stage "Max"
8 = Push-button, blower stage "AUTO"
9 = Push-button, blower stage "Min"
10 = Fresh-air/ventilation switch

Test step	Switch position V	Switch position Ω	Remarks	Test specifications (reading)
24	22	10	Heating-water valve actuation: Press push-button "EC" at operating element.	< 2 V Determine by feeling that there is no heating effect available.
24.1	22	10	Turn temperature thumbwheel until latched in "Max" position (wait till adjusted).	> 10 V Determine by feeling that there is no heating effect available.
24.2	22	10	Disconnect bridge, socket 1/socket 2 at universal test adapter. Connect ammeter between socket 1 and socket 2. Turn temperature thumbwheel until latched in "Min" position.	< 1 A
25	23	10	Re-make bridge, socket 1/socket 2 at universal test adapter. Temperature thumbwheel in center position (22 °C) press blower push-button "AUTO" at operating element (wait till adjusted).	1,4...4,5 V depending upon interior temperature and ambient temperature
25.1	23	10	Press blower push-button "Max" at operating element.	≥ 6 V
25.2	23	10	Press blower push-button "Min" at operating element.	0,9...1,1 V
25.3	23	10	Press push-button "0" at operating element.	approx. 0 V

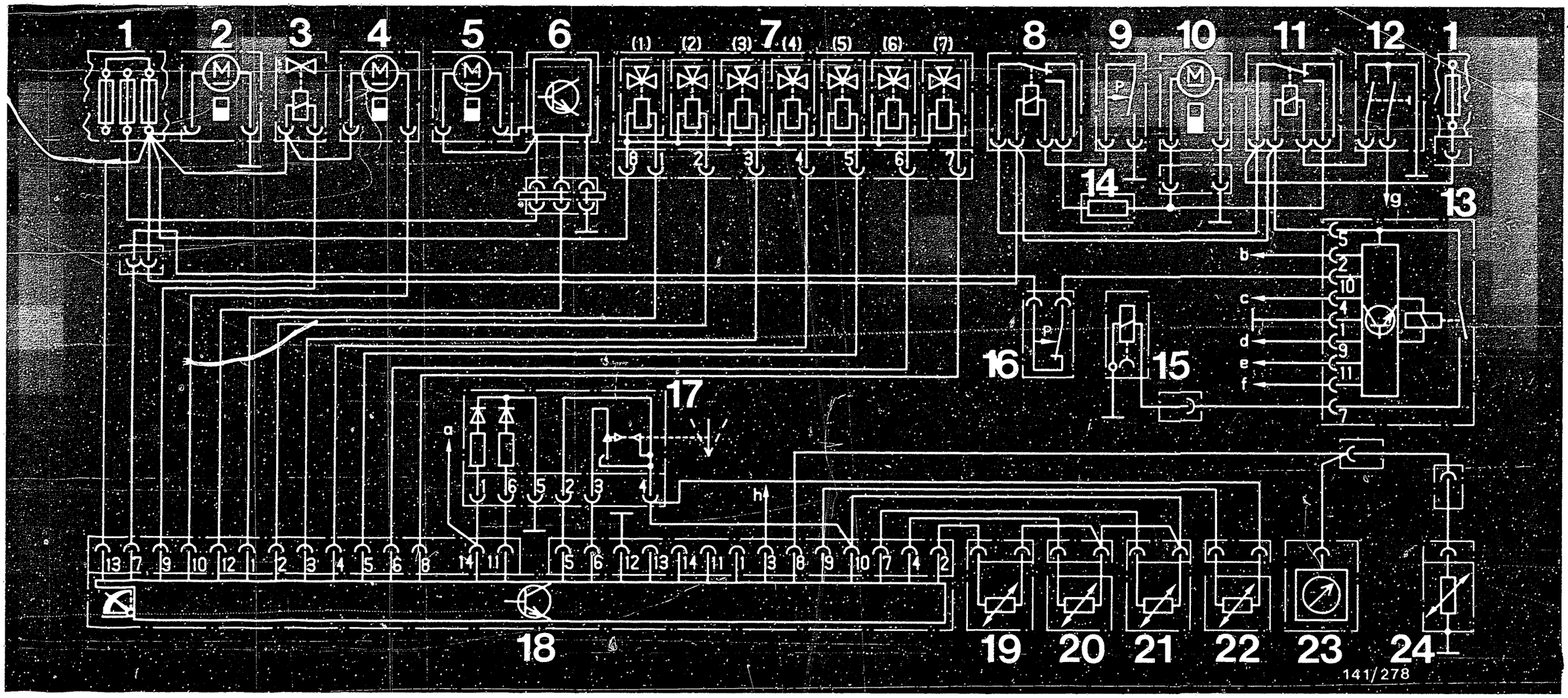


1 = Temperature thumbwheel
2 = Push-button "DEF"
3 = Push-button "BI-LEV"
4 = Push-button "AC"
5 = Push-button "EC"
6 = Push-button "0"
7 = Push-button, blower stage "Max"
8 = Push-button, blower stage "AUTO"
9 = Push-button, blower stage "Min"
10 = Fresh-air/ventilation switch

TEST SPECIFICATIONS

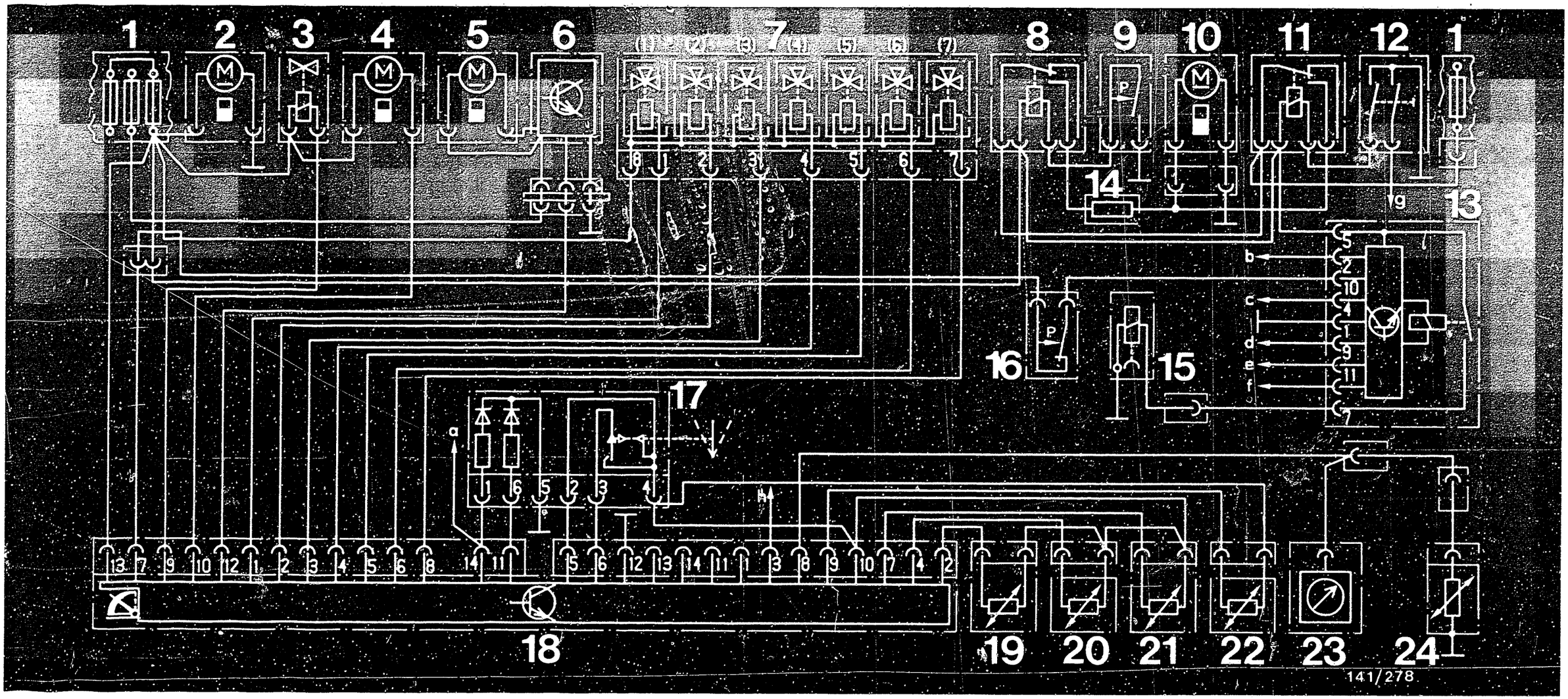
Resistance Interior temperature sensor	15... 6 k Ω at +15...+35° C
Resistance Discharge temperature sensor	15... 6 k Ω at +15...+30° C
Resistance Evaporator temperature sensor	20... 6 k Ω at +10...+35° C
Resistance Ambient temperature sensor	7...2,7 k Ω at + 5...+25° C
Voltage at coolant temperature sensor	6,5...2,0 V at +20...+90° C
Resistance Change-over valves	approx. 50... 80 Ω
Resistance Speed sensor Coolant compressor (only 6-cylinder engine)	approx. 530...650 Ω

For production reasons:
continued on the following
coordinate.



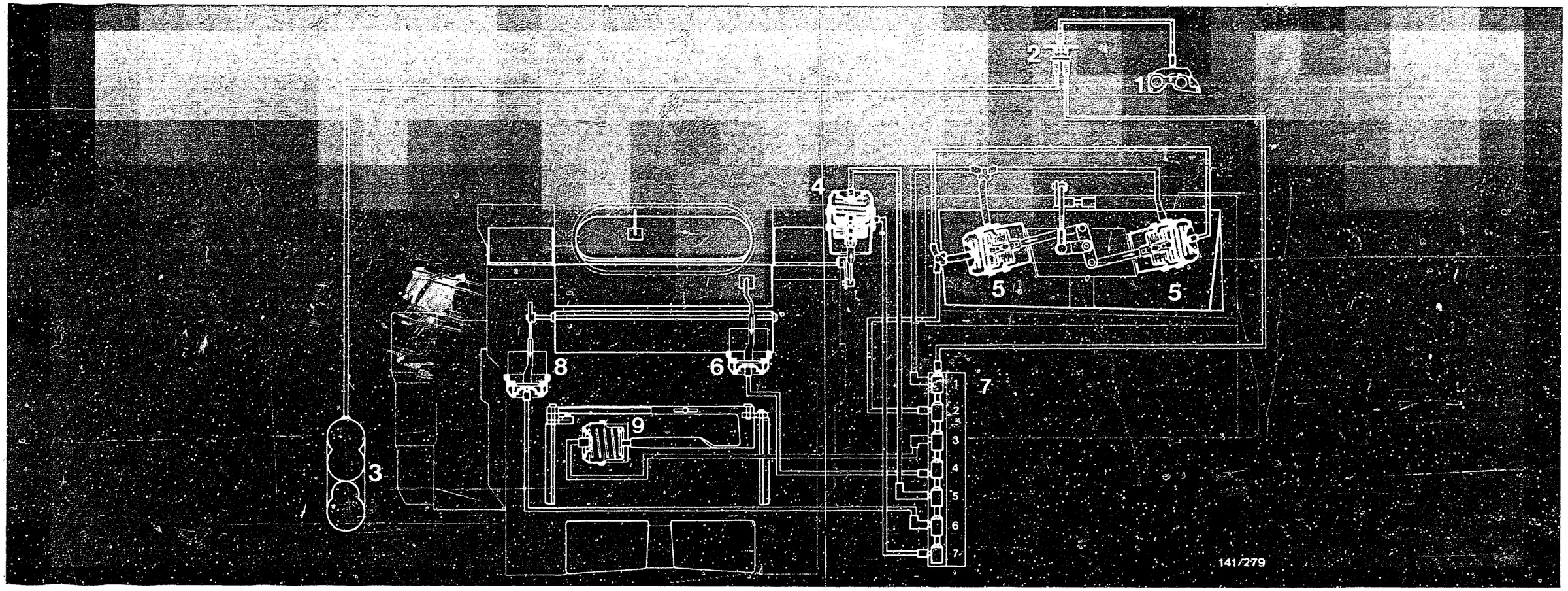
1 = Fuse and relay box
2 = Ventilation fan, interior temperature sensor
3 = Heating-water valve
4 = Heating-water pump
5 = Blower motor
6 = Blower controller
7 = Change-over valve strip
7.1 = Fresh-air/ventilation flap (small stroke)
7.2 = Fresch-air/ventilation flap (large stroke)
7.3 = Footwell flaps
7.4 = Center-nozzle flap
7.5 = Defroster-nozzle flaps (large stroke)
7.6 = Air-renewal flap
7.7 = Defroster-nozzle flaps (small stroke)
8 = Relay, auxiliary fan series resistor
9 = Pressure switch, auxiliary fan Off 15 bar / On 20 bar
10 = Auxiliary fan
11 = Relay, auxiliary fan
12 = Temperature switch 110° C (only 6-cylinder engine) Temperature switch 105/ 115° C (only 8-cylinder engine)
g = To control unit, compressor cut-off (only 8-cylinder engine)

OPERATING-PRINCIPAL DIAGRAM, AUTOMATIC AIR CONDITIONER W 124



13 = Control unit, compressor cut-off
 b = TD signal
 c = To Jetronic control unit term.19
 (only 6-cylinder engine)
 To control unit, low-idle-speed control
 term.3 (only 8-cylinder engine)
d,e= To speed sensor, refrigerant compressor
 (only 6-cylinder engine)
 f = To temperature switch
 105/115° C (only 8-cylinder engine)
14 = Series resistor, auxiliary fan
15 = Magnetic coupling, refrigerant compressor
16 = Pressure switch, refrigerant compressor
 Off 2.0 bar / On 2.6 bar
17 = Switch, fresh air/ventilation
18 = Control unit and operating element,
 automatic air conditioner
 a = Term.58d
 h = To electronic speedometer
19 = Interior temperature sensor
20 = Evaporator temperature sensor
21 = Discharge temperature sensor
22 = Ambient temperature sensor
23 = Temperature indicator, coolant
24 = Temperature sensor, coolant

OPERATING-PRINCIPAL DIAGRAM, AUTOMATIC AIR CONDITIONER W 125 (CONTINUED)



1 = Vacuum connection at intake manifold
2 = Non-return valve
3 = Vacuum reservoir
4 = Vacuum element, defroster-nozzle flaps
5 = Vacuum element, fresh-air/ventilation flap
6 = Vacuum element, center-nozzle flap

7 = Change-over valve strip
7.1 = Fresh-air/ventilation flap (small stroke)
7.2 = Fresh-air/ventilation flap (large stroke)
7.3 = Change-over valve, footwell flaps
7.4 = Change-over valve, center-nozzle flap
7.5 = Change-over valve, defroster-nozzle flaps (large stroke)
7.6 = Change-over valve, air-renewal flap
7.7 = Change-over valve, defroster-nozzle flaps (small stroke)
8 = Vacuum element, air-renewal flap
9 = Vacuum element, footwell flaps

DIAGRAM OF VACUUM LINES W 126

TEST EQUIPMENT AND TOOLS

Description	Designation	Part No.
Universal test adapter	ETT 018.01	0 684 101 801
Adapter lead	KDHK 0010	
Electrics tester or Multimeter	ETT 014.00 e.g. Pontavi	0 684 101 400 Commercially available
Refrigerant spray		Commercially available
Extractor hook for combi instrument	Mercedes-Benz	126 589 033 300
Thermal conduction compound		5 942 860 003
Vacuum pump	e.g. Mityvac obtainable from: Korinth Ludwig-Kloos-Str.21 D-6450 Hanau 7 /Steinheim	

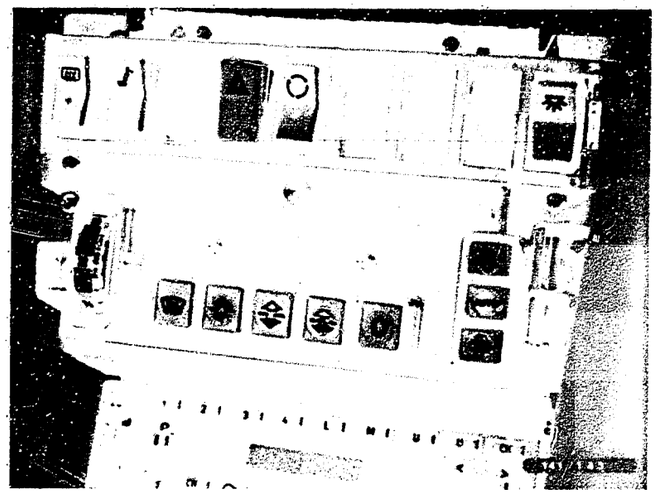
For production reasons:
continued on the following coordinate.

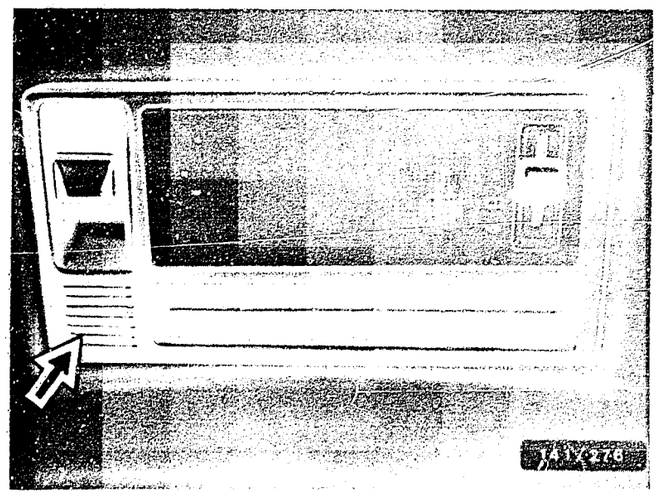
INSTALLATION POSITION OF COMPONENTS

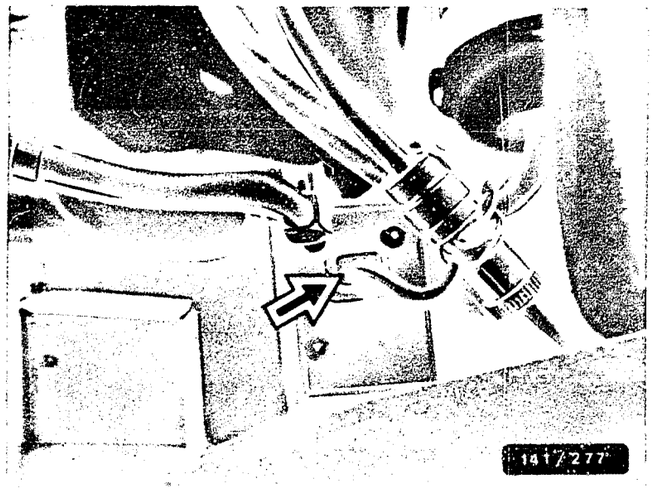
The operating element with integral control unit of the Mercedes-Benz automatic air conditioner is installed in the center of the center console (see upper illustration).
Panel already removed in illustration.
To connect the adapter lead, the operating element must be removed.

The interior temperature sensor is installed in the roof in the operating element of the interior lamp (see center illustration).

The evaporator temperature sensor is positioned in the air flow behind the evaporator (see lower illustration).
To remove and install, unclip the sensor from the evaporator.







INSTALLATION POSITION OF COMPONENTS (CONTINUED)

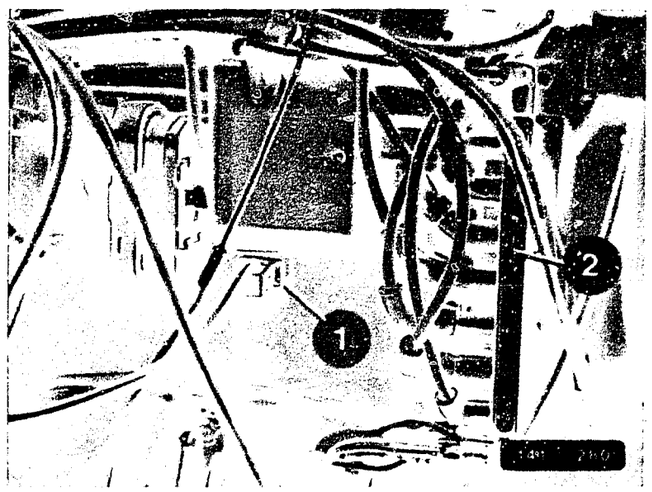
The heating-water valve and heating-water pump are positioned at the right (referring to forward direction of travel) in the engine compartment (upper illustration, arrows).

The discharge temperature sensor (see lower illustration, Item 1) is clipped into the heater casing.

N o t e :
The discharge temperature sensor is accessible only after removing the center- console cover (ashtray, switches and radio must be removed).

The change-over valve strip and vacuum elements are positioned at the right (forward direction of travel) at the heater casing (see lower illustration, Item 2).

N o t e :
Valve strip (not Bosch part) can be exchanged only as a complete unit.



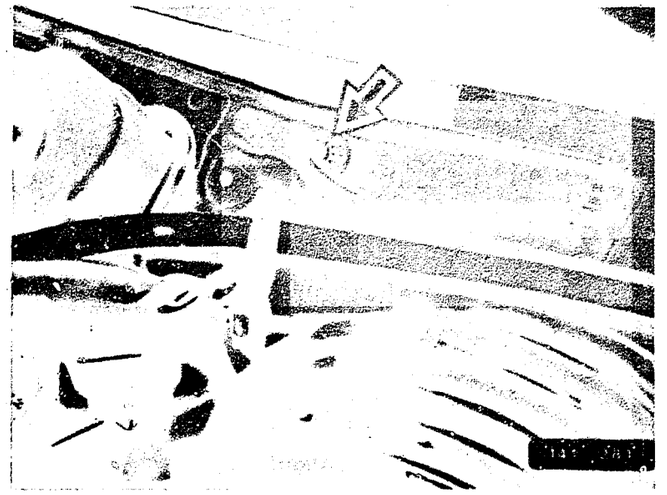
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

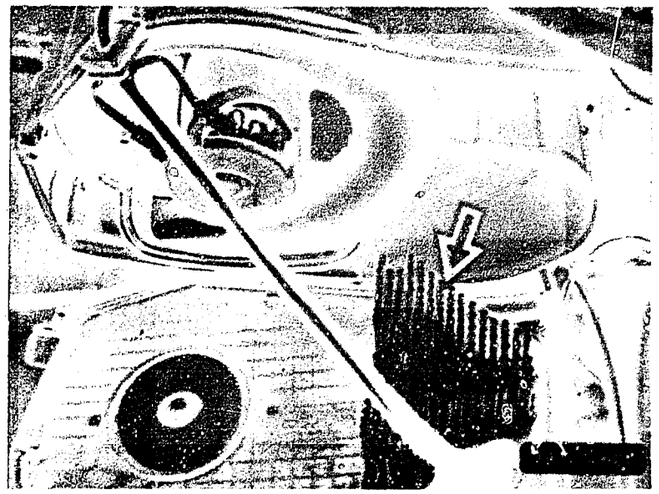
The ambient temperature sensor is positioned at the blower casing (see upper illustration).

The blower controller (see lower illustration, arrow) is installed in the air duct of the blower casing.
To replace the blower controller, unscrew it from the heat sink.
Before installing a new blower controller, grease the contact surface first with thermal conduction compound.

N o t e :
Thermal conduction compound is poisonous. After applying, wash hands.

The compresser cut-off control unit is installed in the engine compartment (no illustration).





T A B L E O F C O N T E N T S

Trouble-shooting instructions : REN-5001

BOSCH system : VE..F.. pump

Make of vehicle : RENAULT

Basic microcard : REN-500

1. SPECIAL FEATURES

* This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following Renault models with diesel engine J8S 2.0 L 48 kW (65 bhp) and 65 kW (88 bhp):

  Renault R 21 D (03.86->)
  Renault R 21 TD (03.86->)

2. TEST SPECIFICATIONS

2.1 Idle speed:

R 21 D	700...800 min $^{-1}$
R 21 D-Turbo	700...750 min $^{-1}$

2.3 Coordination, pump - engine:

2.3.1 Testing/adjusting "static"

Engine position: Cyl. 1 at TDC

Check value:
Pump position: 0.68...0.72 mm after BDC

Setting:
Pump position: 0.70 mm after BDC

2.3.2 Testing "dynamic"

At idle speed
Start of injection 13.5° before TDC

2.4 Compression: 20 to 30 bar

2.5 Charge-air pressure: 0.6 bar

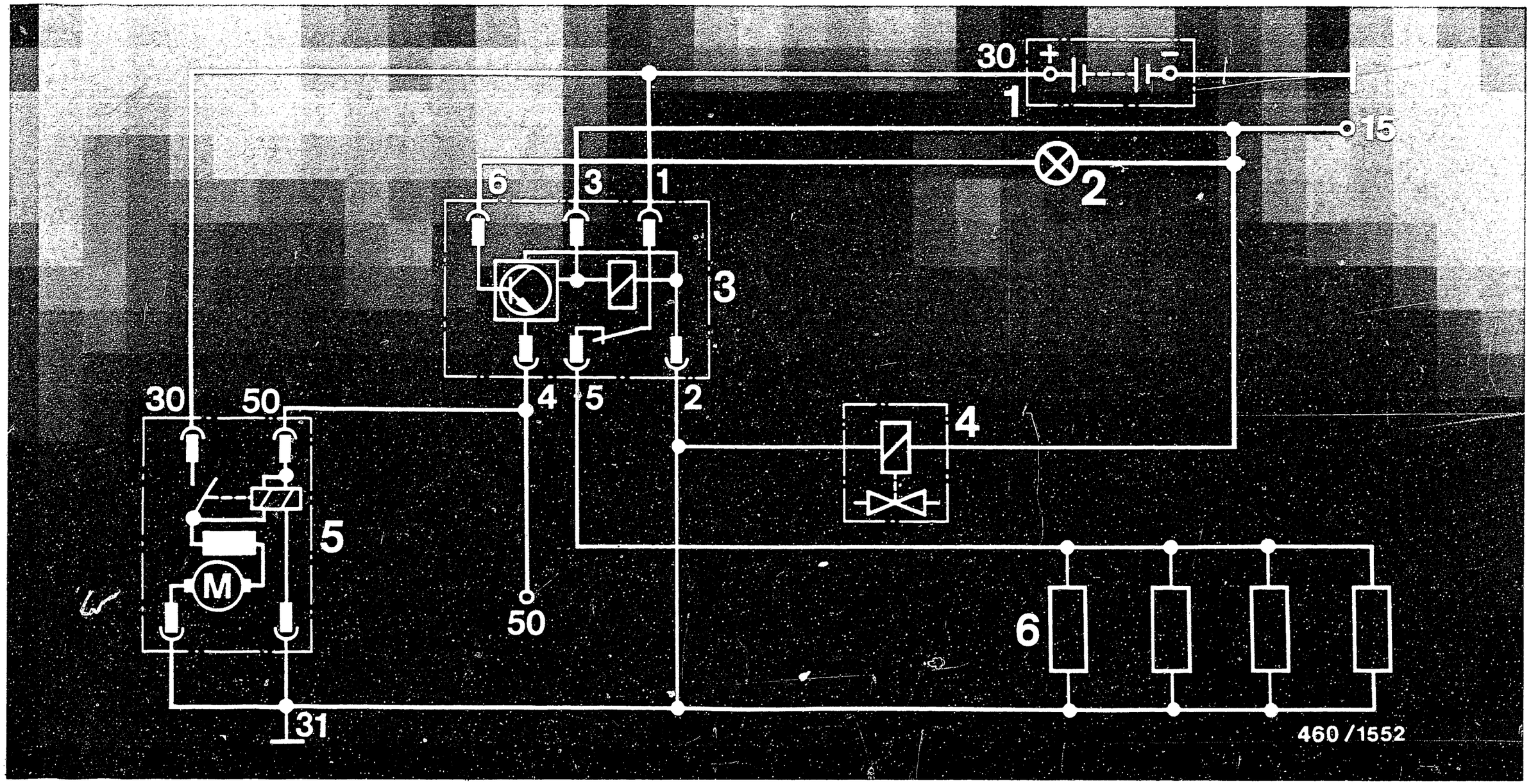
2.6 Toothed-belt tension

Scale interval 14...15

2.7 Tightening torques

Injection-pump gear (hexagon nut)	50 Nm
Fuel lines	25 Nm
Fastening screws of injection pump	25 Nm
Screw plug	10 Nm
Nozzle-holder assembly	17 Nm
Angle bracket of injection pump	25 Nm
Hollow screws, fuel lines	25 Nm
Sheathed-element glow plugs	40 Nm

For production reasons:
continued on the following
coordinate.



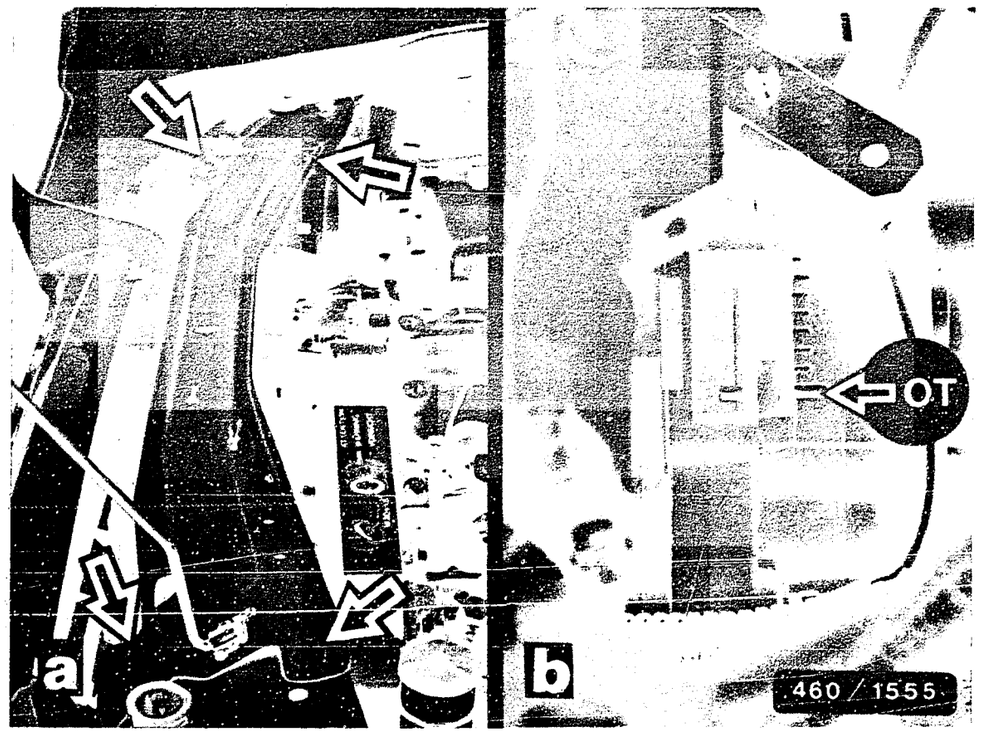
1 = Battery
2 = Preheating repeater lamp
3 = Glow-time control unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

3. TERMINAL DIAGRAM FOR PREHEATING SYSTEM

D05 ⟹

D06 ⟸

Description	Part number	Application
Puller	KDEP 1118	Pulling off injection-pump gear
Setting mandrel	KDEP 1123	Locking crankshaft
Holding device	KDEP 1124	For securing pump-drive gear
Measuring tool	KDEP 1085	Coordination, pump - engine
Toothed-belt tester	KDEP 1121	Checking toothed-belt tension
Pressure gauge 0...1.6 bar	KDJE-P 100 or e.g. Wilka No.4184	Checking charge-air pressure
Box wrench	KDEP 1115	Loosening/ tightening fuel-injection tubing



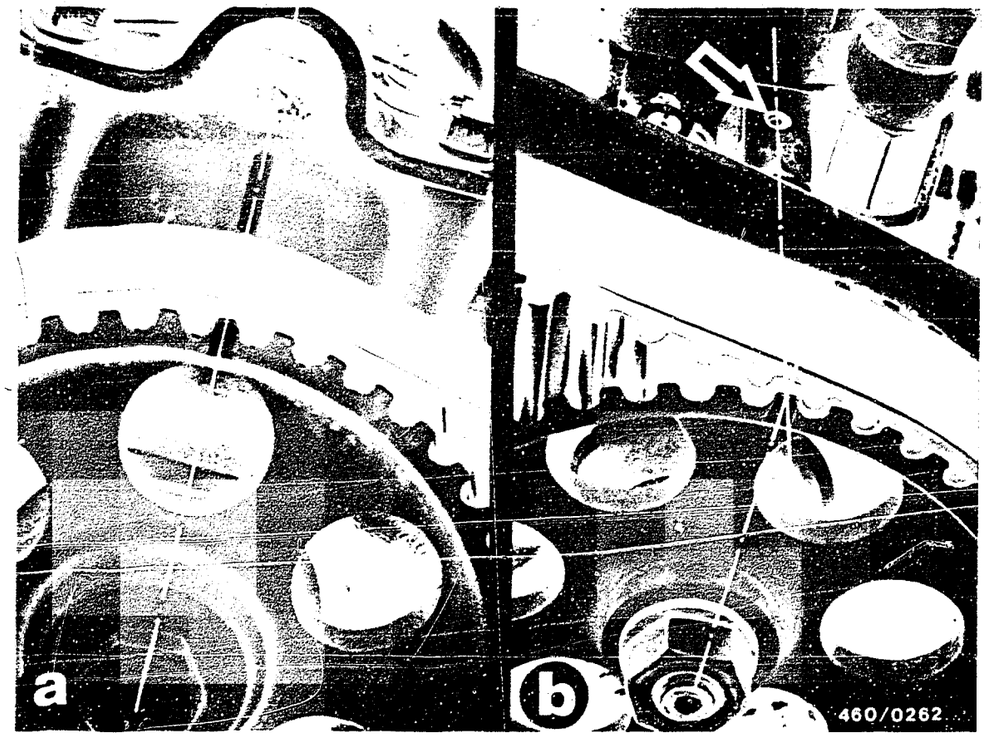
5. REMOVING INJECTION PUMP

Disconnect negative cable at battery.

Remove cross strut above the radiator (illustration a - arrows), V-belt from generator and power-steering pump as well as toothed-belt protective cover.

4. Shift into gear and chock up left-hand front wheel.

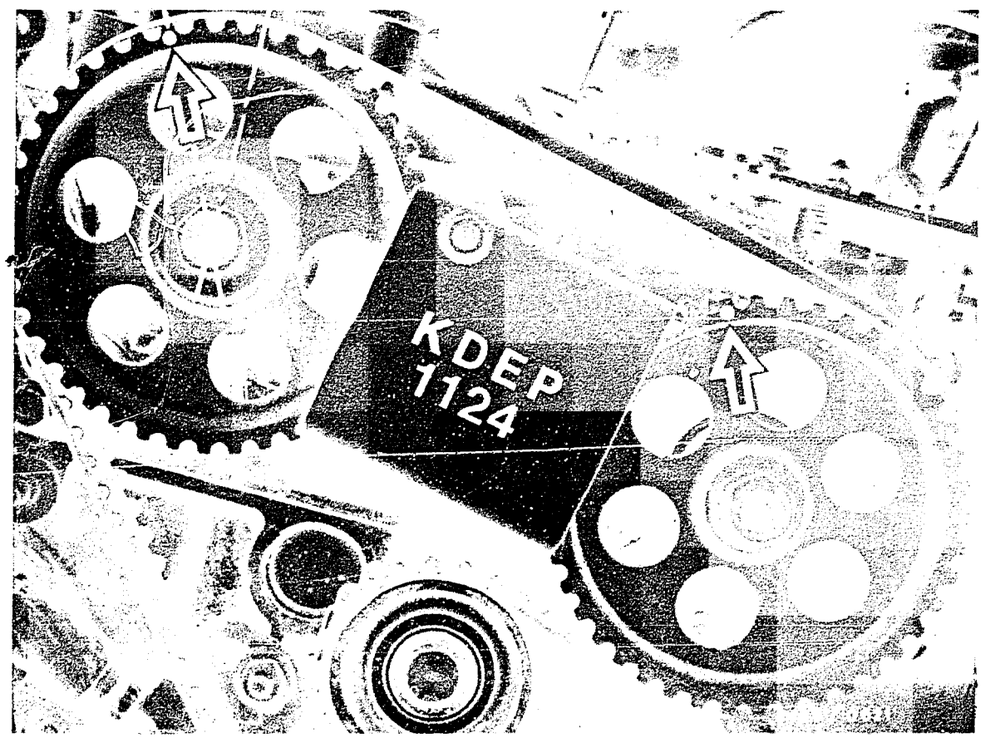
By turning the front wheel, turn the crankshaft to TDC of cylinder 1 (illustration b).



In this engine position, test the position of the timing gears:

The marking on the camshaft gear must be aligned with the center axis of the valve cover (Figure a).

The marking on the pump drive pinion will then be pointing to the center axis of the governor-shaft (arrow, Figure b).



Turn the camshaft back until the marking on the camshaft gear is three teeth ahead of the TDC marking on the valve cover.

Insert holding device KDEP 1124 between the camshaft gear and pump drive pinion and fasten it in this position (see illustration).

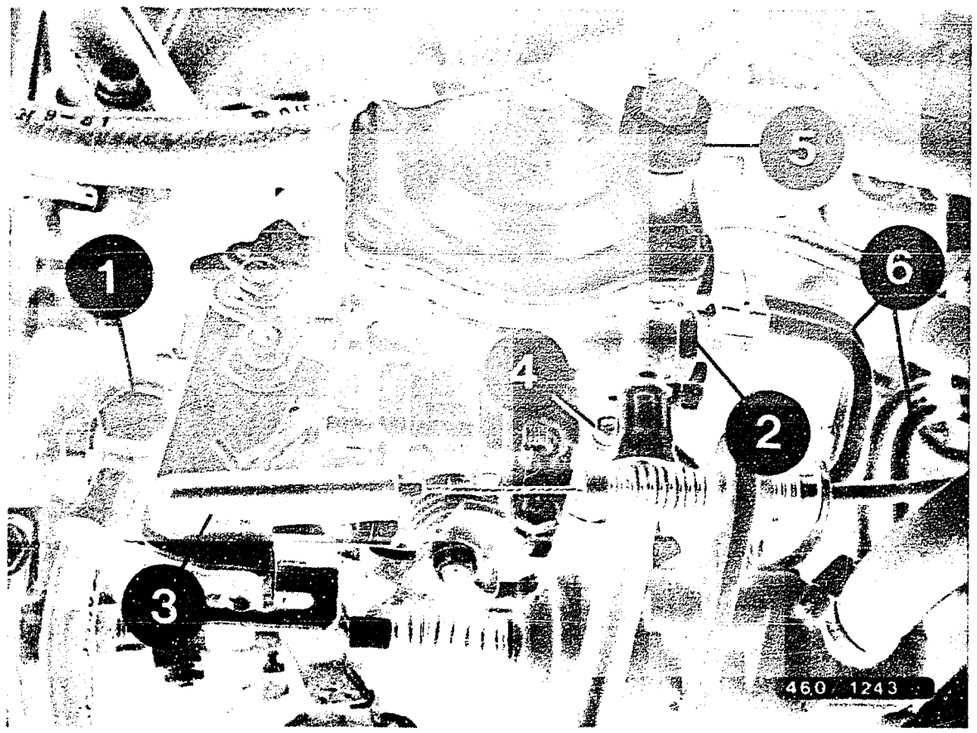
Loosen the fastening nut on the fuel-injection-pump pinion and unscrew it about 2 turns.

Use puller KDEP 1118 to loosen the injection-pump pinion from the cone of the input shaft.

Remove the fastening nut and washer.

N o t e :

Do not remove the toothed belt from the timing gear.

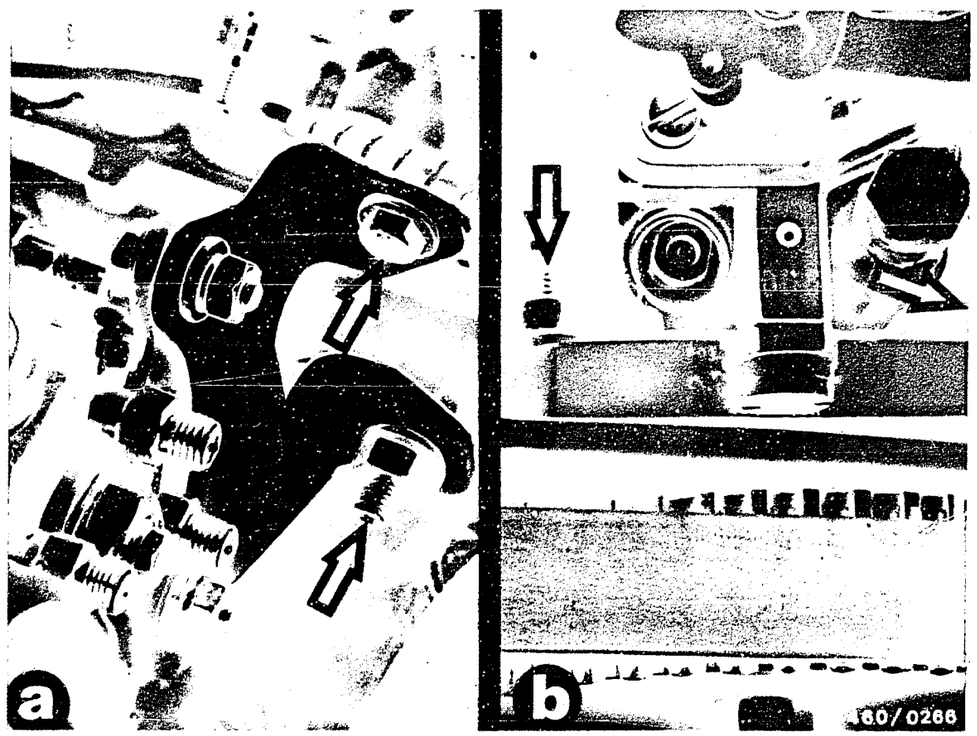


1 = Fuel supply line
2 = Fuel return line
3 = Bowden cable to control lever
4 = Connection cable to ELAB
5 = Charge-air-pressure connection
(R 21 D-Turbo)
6 = Fuel-injection tubing

Remove the bowden cable at the control lever of the fuel-injection pump, the connecting cable to the electric shutoff device, fuel lines, and charge-air-pressure connection if present. (Prevent loosening of the delivery-valve holders by counterholding)

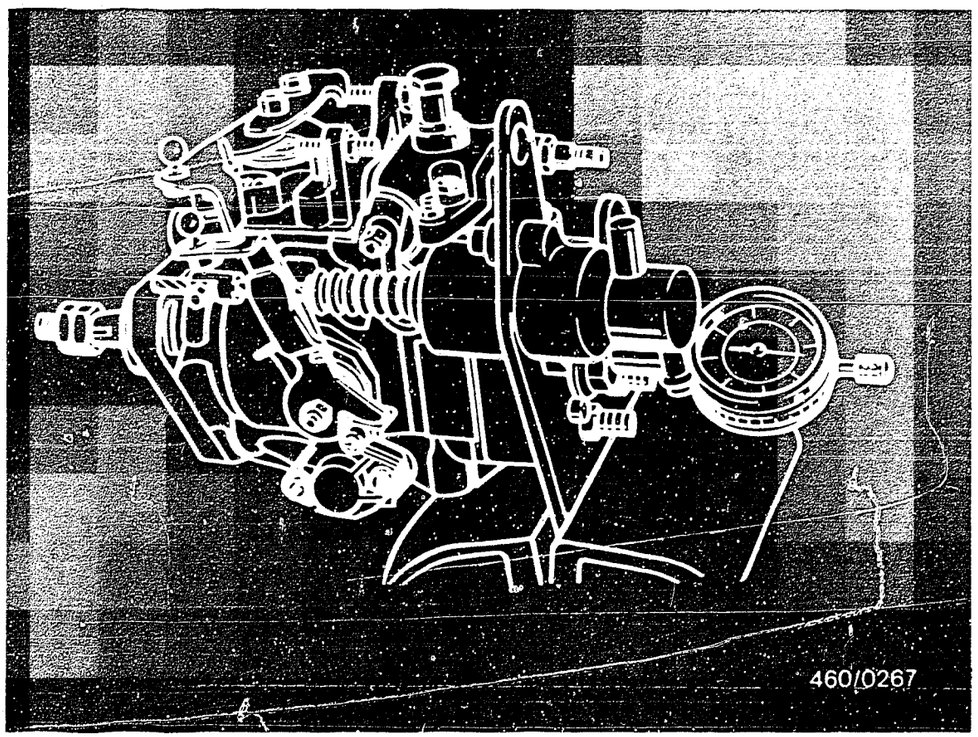
Pinch off coolant hoses a short distance after the expansion elements of the idle increase using commercially-available spring clips.

Loosen hose clamps and remove coolant hoses.



Unscrew the fastening screws of the injection-pump angle bracket (arrows, illustration a).

Remove the fastening screws of the injection pump at the pump flange (arrows, illustration b) and remove the injection pump from the engine.



6. INSTALLING INJECTION PUMP

Clamp injection pump in vice (see illustration).

Screw two hexagon nuts on to drive shaft of injection pump and lock.

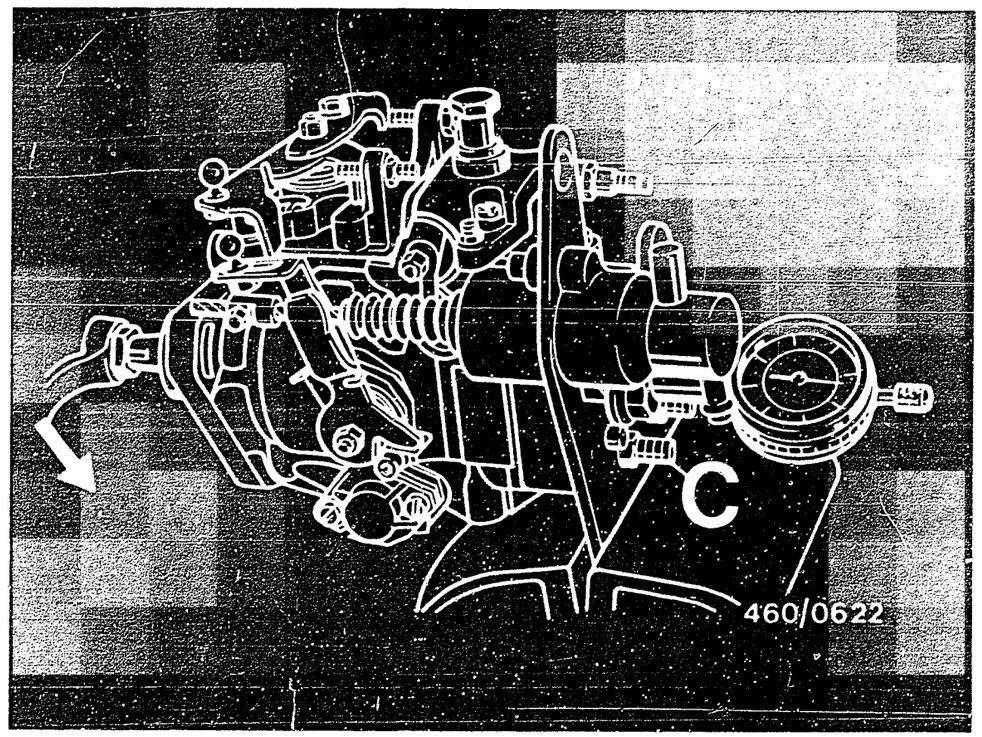
Remove bleeder screw of injection pump.

Mount measuring tool KDEP 1085 into thread bore of bleeder screw.

Mount dial indicator 1 687 233 011 with measuring foot into measuring tool KDEP 1085 (see illustration).

N o t e :

When testing and adjusting the start of delivery, the cold-start injection advance must be in neutral position.

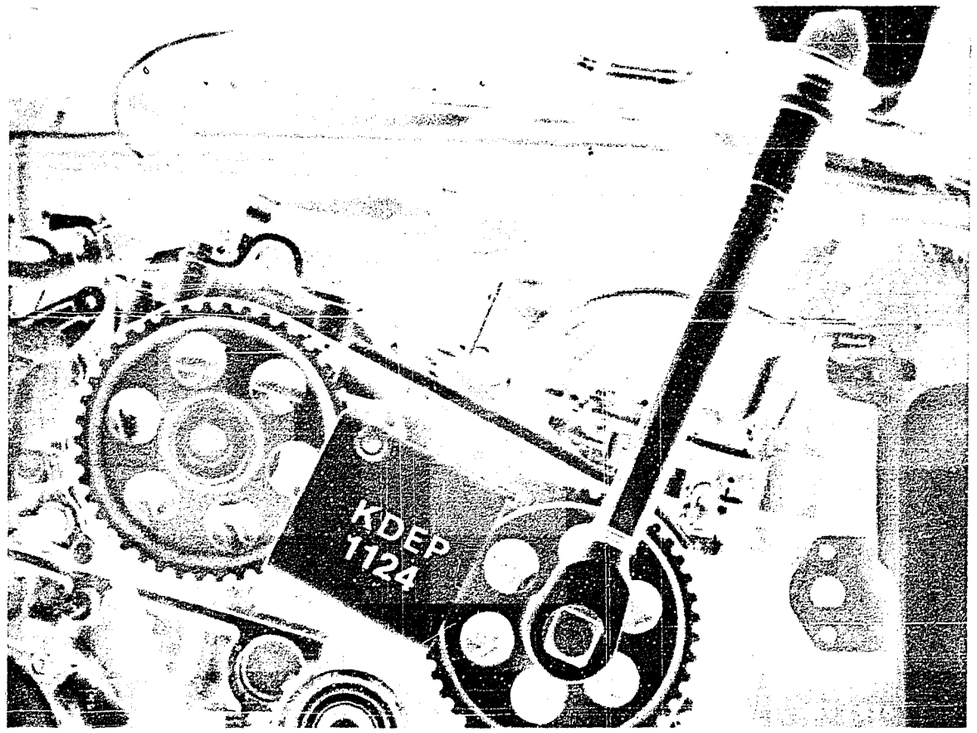


Turn pump shaft in direction of arrow until distributor-pump plunger reaches BDC.

In this position, preload dial indicator approx. 3mm and set to "0".

Turn drive shaft further in direction of arrow until the keyway (once more at BDC of distributor-pump plunger) points to outlet "C" (see illustration) of distributor head.

Unscrew hexagon nuts (do not turn drive shaft any more).



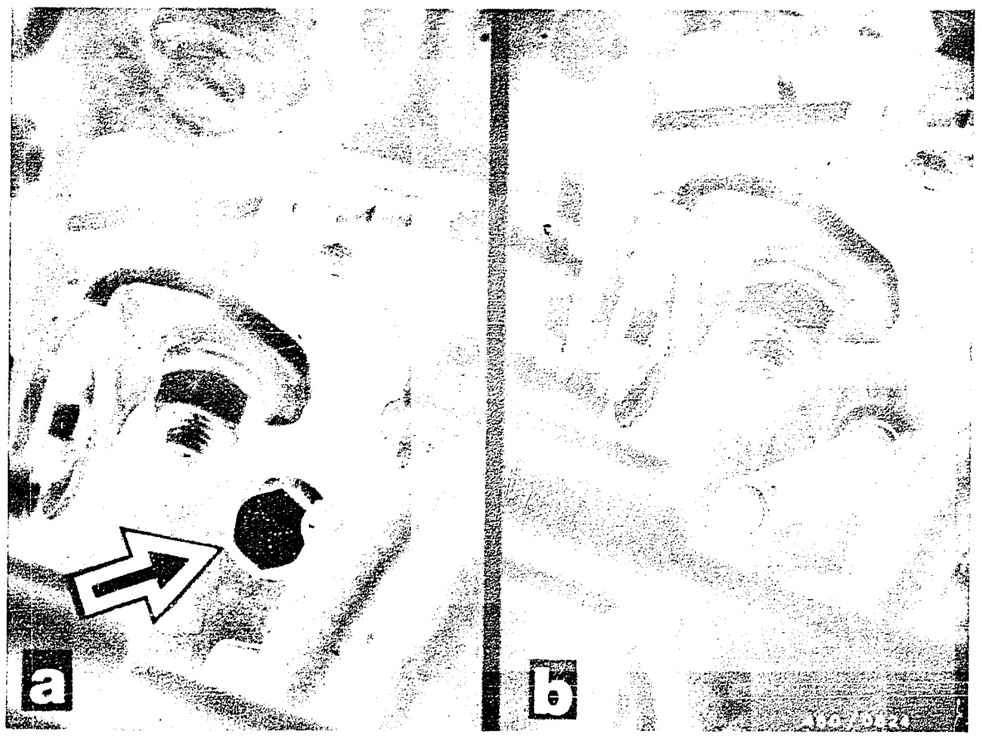
Insert Woodruff key into slot of drive shaft.

Guide injection pump into bore of pump drive gear.

Screw on fastening nuts of injection pump by hand.

Mount washer and fastening nut of pump drive gear and tighten to 50 Nm.

Remove holding device KDEP 1147.



Turn crankshaft in direction of engine twice.

At TDC of cylinder 1, lock crankshaft using setting mandrel KDEP 1123.

To do this, unscrew screw plug at engine block (near to injection pump) (arrow, illustration a) and insert setting mandrel (illustration b).

In this position, dial indicator at injection pump must indicate a plunger lift of 0.70 mm after BDC.

If necessary, correct by pivotting the injection pump.

N o t e :

Poor tensioning of the toothed belt adversely affects the pump setting.

Test toothed-belt tension using belt-tension testing tool KDEP 1121.

Turn vernier sleeve until the lower edge of the sleeve is aligned with the marking on the measuring tongue.

Read off measurement.

Setting: Scale interval 14...15

Checking the setting

Remove setting mandrel KDEP 1123.

Turn crankshaft 1 3/4 revolutions in direction of rotation.

Check whether dial indicator is at "0" at BDC of distributor-pump plunger.

Turn crankshaft further until TDC (engine) and lock using setting mandrel KDEP 1123.

Dial indicator at injection pump must indicate a plunger lift of 0.68...0.72 mm.

Check the position of the timing gears at this engine position:

Marking at camshaft gear must coincide with the center axis of the valve cover.

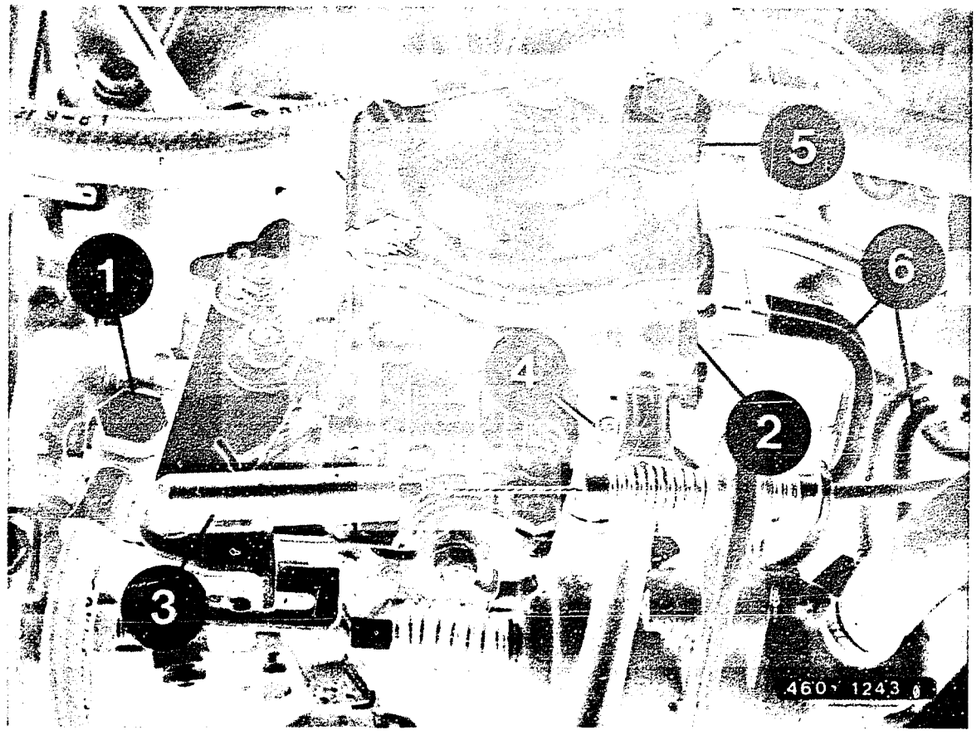
Marking of the pump drive gear points at the same time to the center axis of the governor-axle bore.

Remove setting mandrel KDEP 1123.

Tighten fastening nuts of injection pump to 25 Nm.

Remove measuring tool KDEP 1085 with dial indicator and mount bleeder screw with new copper seal ring.

Mount angle bracket at distributor head of injection pump and tighten fastening screw.

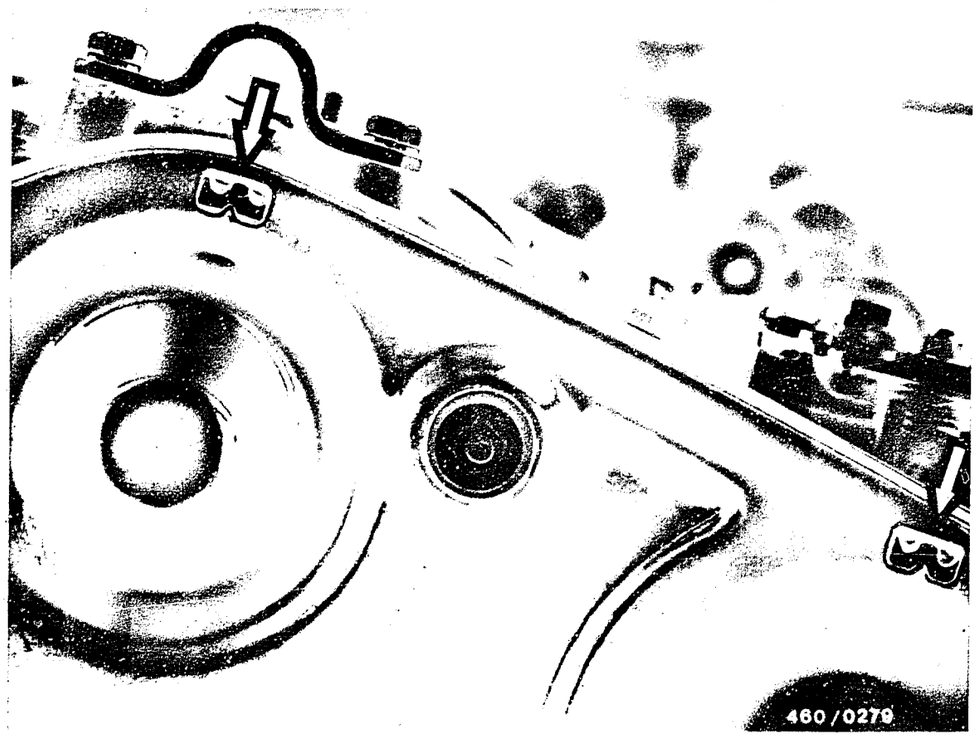


1 = Fuel supply line
2 = Fuel return line
3 = Bowden cable to control lever
4 = Connection cable to ELAB
5 = Charge-air-pressure connection
(R 21 D-Turbo)
6 = Fuel-injection tubing

Connect bowden cable to control lever of fuel-injection pump, the connection cable to the electric shutoff device, fuel lines, and the charge-air-pressure connection if present. (Prevent the delivery-valve holders from turning by counterholding)

Connect coolant hoses to the expansion element of the idle increase, and the negative cable to the battery.

Mount the toothed-belt protection cover, V-belt, and transverse support.



7. TESTING AND ADJUSTING ENGINE TIMING

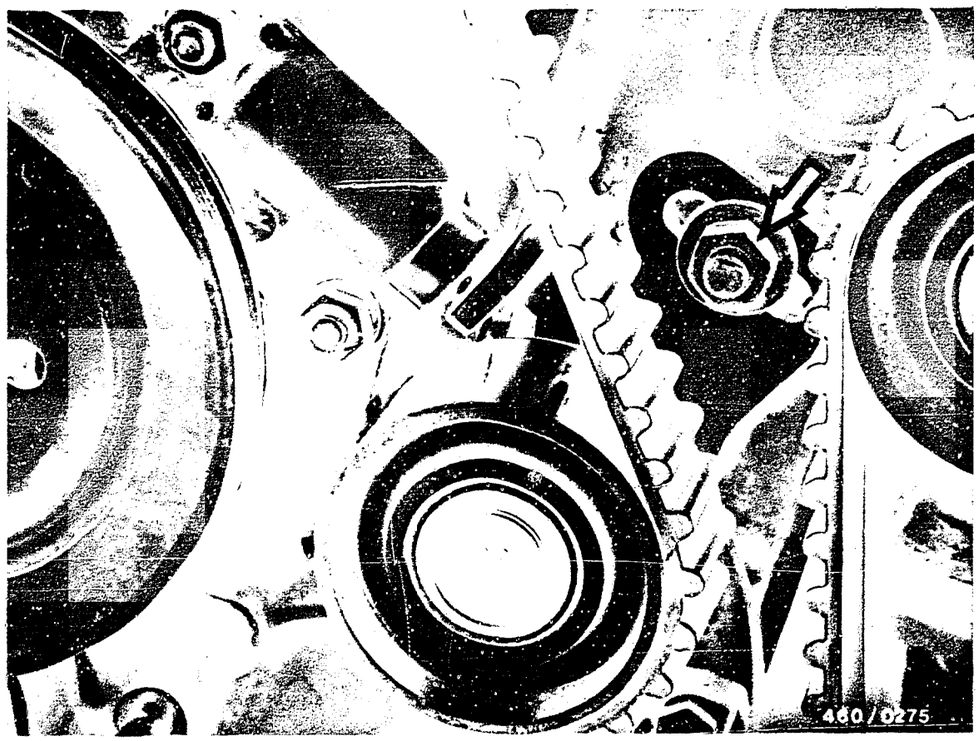
7.1 TESTING ENGINE TIMING

Engage 4th gear and lift front left wheel.

Turn camshaft to TDC of cylinder 1 (by turning front wheel), and hold in this position with setting mandrel KDEP 1123.

Check to see whether markings on the camshaft and fuel-injection-pump gears are in alignment with the needles of the adjustment windows (see illustration).

If these markings are not aligned with their reference marks, adjust engine timing.



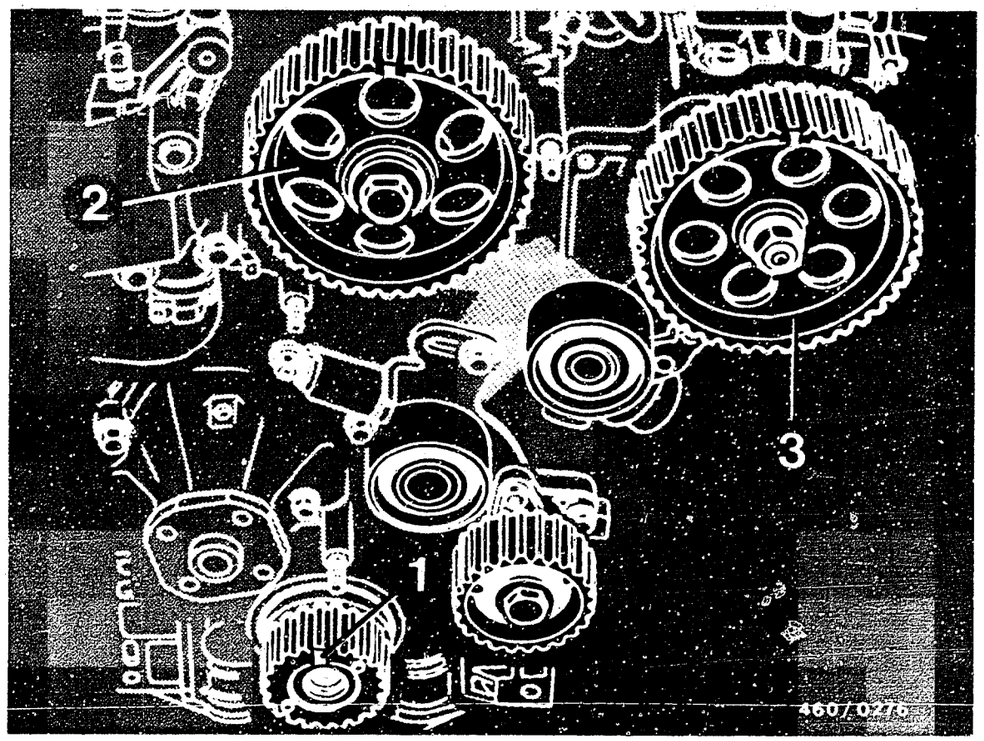
7.2 ADJUSTING ENGINE TIMING

Remove the transverse support above the radiator, the V-belt, and toothed-belt cover.

Loosen the fastening nut of the tensioning-wheel bracket (arrow).

Push the tensioning wheel against the spring tensioner and tighten fastening nut.

Remove toothed belt.



1=Crankshaft gear
2=Camshaft gear
3=Pump drive pinion

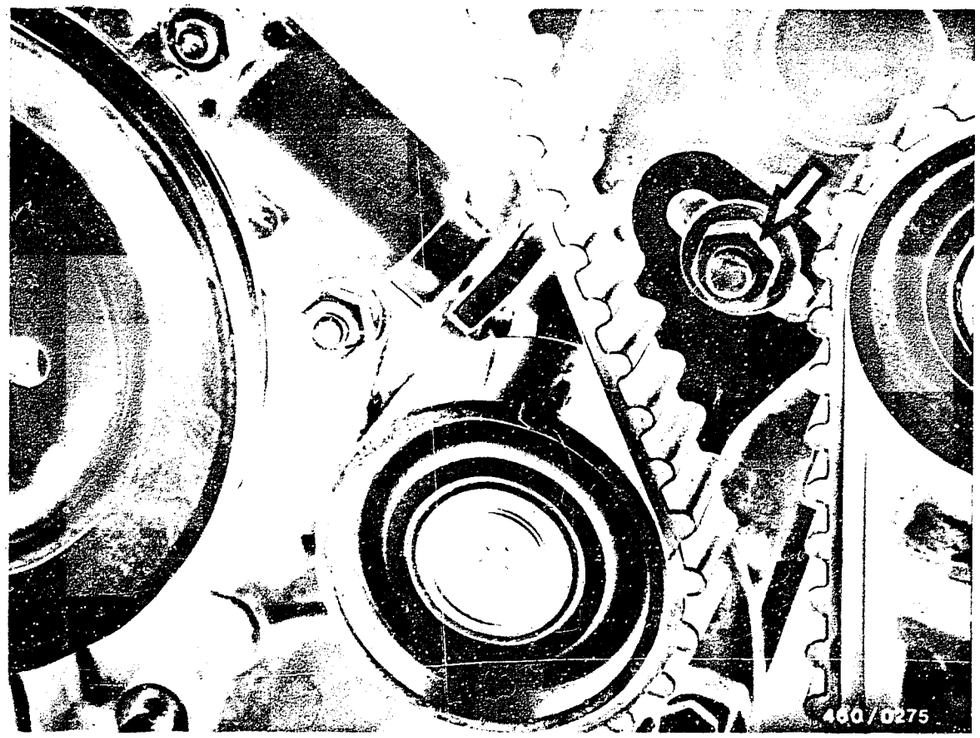
The marking on the crankshaft gear must point upwards.

Turn the camshaft gear so that the marking of the camshaft gear is in alignment with the center axis of the valve cover.

The marking on the pump drive pinion will then point to the center axis of the governor-shaft hole.

N o t e :

By temporarily positioning the toothed-belt cover, the correct position of the camshaft gear and the drive pinion of the fuel-injection pump can be checked through inspection holes.



Mount the toothed belt without changing the positions of the drive gears.

Loosen the fastening bolt of the tensioning-wheel bracket.

Remove setting mandrel KDEP 1123.

Turn the crankshaft two complete turns in the direction of engine rotation until the markings are aligned again.

Tighten the fastening bolt of the tensioning-wheel bracket.

Use belt-tension tester KDEP 1121 to check toothed-belt tension.

Target value: scalar value 14...15

Mount the toothed-belt cover, V-belt, and transverse support.
Check/adjust the coordination of the fuel-injection pump and the engine.

7. TESTING CHARGE-AIR PRESSURE

When working on the turbo-supercharger, keep in mind that even the tiniest contamination particles can cause irreparable damage to the supercharger.

For this reason, never operate the engine without air filter.

Pressure-measuring device KDJE-P 100, or a 0 ... 1.6 bar pressure gauge (e.g. Wika no. 4184) can be used to test charge-air pressure.

7.1 Measuring charge-air pressure

The charge-air pressure is measured under full load, ideally on a chassis dynamometer, at 2250...2750 min^{-1} in the range from 80 ... 100 km/h in 5th gear.

Read charge-air pressure from pressure gauge.

Target value: 0.6 bar

N o t e :

Evaluation of the exhaust turbo-supercharger requires that start of delivery and nozzle-opening pressure be correctly set, there be no leakage in the air-induction or exhaust systems, and that the engine be in good mechnical condition (valve clearance, compression).

If the charge-air-pressure control valve is defective, replace the exhaust turbo-supercharger.

After installation of a new exhaust turbo-supercharger, fill the supercharger with oil and let the engine idle about 1 minute in order to ensure oil supply to the charger.

TABLE OF CONTENTS

Trouble-shooting instructions : VWW-5000

BOSCH System : ABS

Make of vehicle : VW (Volkswagen)

Basic microcard : ALL-507

SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following model:

* VW Passat Syncro Injection (9.1986 ->)

Test with ABS2 LED tester.

The ABS for this vehicle operates with 4 wheel-speed sensors and 3 hydraulic ducts.

The vehicles are equipped with an interaxle differential lock and a rear-axle differential lock. They can be engaged and disengaged via a 2-stage push-pull switch.

When a lock is engaged, the ABS is automatically switched off.

The driver may decide whether to drive with ABS or differential lock.

Via the push-pull switch, intake-manifold pressure reaches a pneumatic final controlling element which brings the lock in the differential into operation via an actuation lever.

When the lock is switched, an electric switch at the differential is mechanically actuated and this switches the current supply for the ABS off.

In addition to the ABS indicator lamp, the indicator lamp for the corresponding differential lock lights up simultaneously.

TEST SPECIFICATIONS / TEST REQUIREMENTS

For reasons of safety, the ABS must be tested only with the ABS tester. The rapid diagnosis chart contains all the important test specifications together with instructions for testing and trouble-shooting.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

* Regulator tire size fitted?

* Check for firm seating and corrosion of ground of return supply pump and of combi relay term.31 .

* Check for leaks in hydraulic connections and sealing points at hydraulic modulator (visual examination).

* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check the battery and power supply (generator, regulator and voltage drops).

* If the ABS warning lamp lights up constantly and does not go out, check the following points:

- Multiple plug sitting correctly on controller and latched?

- All plug contacts O.K.?

- Spring contacts latched?

- Check installation position for correct seating of seal ring in controller plug: rounded side downwards.

- Check for correct assignment of wheel-speed-sensor leads at controller plug.

Wheel-speed sensors:
front left to term.22 and term. 4.
front right to term.23 and term.21.
rear left to term. 8 and term. 9.
rear right to term.24 and term.26.
Rear axle to term. - and term. -.

- V-belt snapped?
(Generator provides no voltage, charge-indicator lamp and ABS warning lamp light up.

* For checking, switch on ignition to all program-selector-switch positions (tester operates with current supply from vehicle battery).

* Observe LED (green) for current supply in all program-selector-switch positions.

* Connect ABS 2 LED tester to ABS wiring harness.

C A U T I O N !

Disconnect and connect controller only with ignition switched off.
Do not run with tester connected!
Repeat the complete test program after each repair.
The Antiskid System is a vehicle safety system.
Work on this system demands detailed knowledge of the system.
The conventional brake system must be O.K.

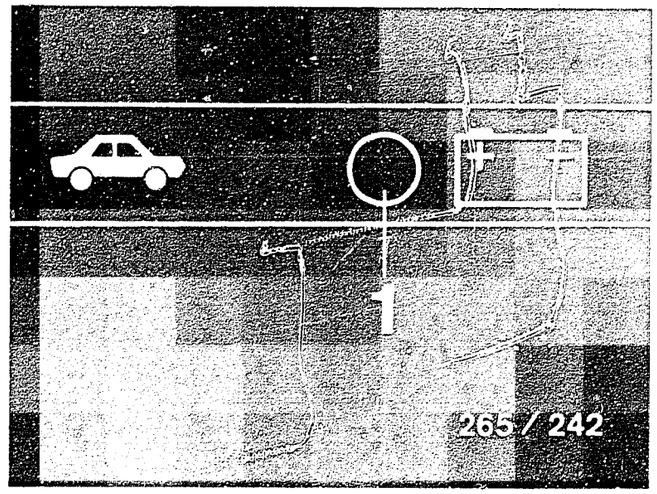
<u>General information for trouble-shooting:</u>

Check all leads for short circuit to ground and contact with positive lines and watch out for rubbed and pinched locations.

RAPID DIAGNOSIS CHART TO ABS 2 LED TESTER

Do not run with tester connected!

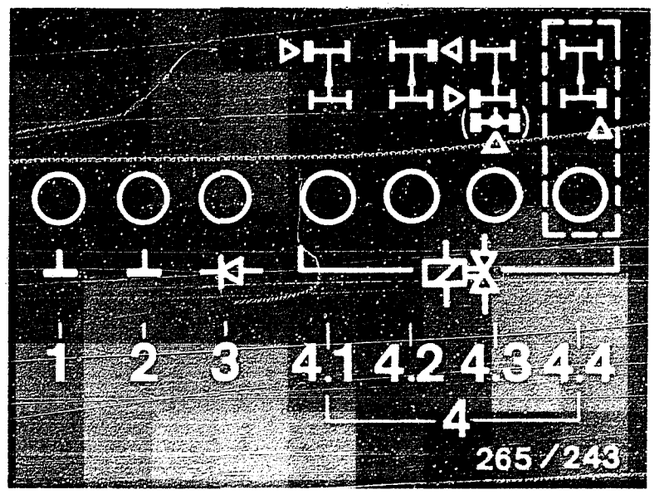
Program-selector-switch position1 to 6



Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Voltage supply (term.- and (term.20	Ignition on	LED 1 (upper illustration) lights up continuously	* 4-pin plug connection defective (1) * Battery insufficiently charged * Voltage drops too high (-) * Over-voltage protection relay defective (-) * Check lead to driving switch term. 15.

Rapid diagnosis chart (Continued 1)

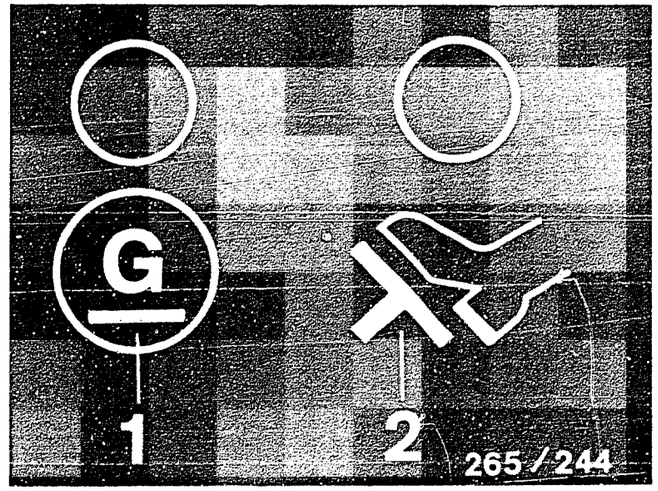
Program-selector-switch position 1 (3-duct hydraulic modulator)



Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Ground (term.10, term.34) Diode for warning lamp (term.32, term.-) Solenoid-operated valve internal resistances (term.18, term.-, term.-, term.35) Off-position and ground of valve relay ABS warning lamp	Ignition on	8 LEDs (1 to 4,3) light up equally brightly (upper ill.) ABS warning lamp in vehicle must light up	* LED 1 and / or 2 (upper illustration) do not light up: Check ground terminals for short circuit. (29) * LED 3 (upper illustration) does not light up: diode defective, check ground of valve relay. (2) * One or more LED 4 do not light up: Check corresponding plug connection for solenoid-operated valve and leads. (-) Solenoid-operated valve, internal resistance 0,7...1,7 Ω * All LED 4 and LED 3 do not light up: Check ground of valve relay, valve relay defective. (-) * Weak lighting of a LED means contact resistance in corresponding current path. (-) * ABS warning lamp does not light up: warning lamp defective. Note: all other 7 LEDs light up (-)

RAPID DIAGNOSIS CHART (CONTINUATION 2)

Program-selector-switch position 2

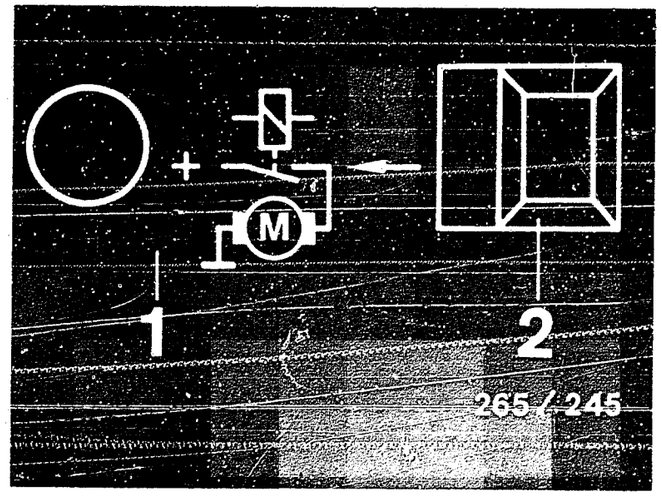


Test on (Measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Generator voltage of term. 61 term. 15)	Ignition on	LED 1 (upper illustration) lights up.	* LED sometimes goes out only after snap acceleration (test is then O.K.) (-)
	Start engine	LED 1 (upper illustration) goes out with engine running	* Check lead to generator term. 61 * Generator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (upper illustration) lights up	* Stop-lamp switch defective. (-) * Check lead to stop-lamp switch.
	Actuate brake pedal	LED 2 (upper illustration) goes out	* Lead at stop-lamp switch incorrectly connected.

Rapid diagnosis chart (Continued 3)

Program-selector-switch position 3

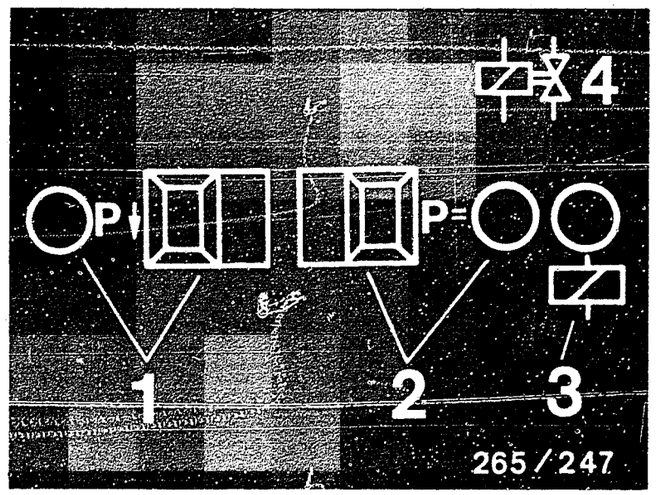
Test on (measurement at terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble (see coordinate)
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, constantly press push-button 2 (upper illustration)	LED 1 lights up, pump motor runs. After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	* Motor relay defective (–) * Check ground and positive terminal of hydraulic modulator (–) * Check leads from controller term.14 and term.28 to hydraulic modulator term.9 or term.11. (–) * Pump motor defective (–)



Program-selector-switch position 4 not applicable

RAPID DIAGNOSIS CHART (CONTINUED 4)
Program-selector-switch position 5 (3-channel hydraulic modulator)

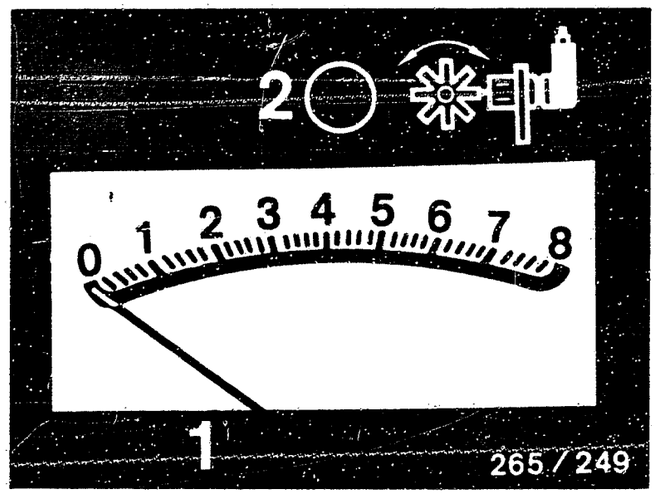
Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Valve relay op. (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective (-)
Solenoid-operated valves in hydraulic mod. for function and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. (Lower ill.)		* Repeat test with engine running * Valve relay (make contact) defective (-) * Brake in line from valve relay term.87 to B+ (-) * Brake leads at hydraulic modulator mixed up (-) * Current value not obtained (LED P arrow or P= goes out; upper illustration): Battery insufficiently charged. Repeat test with engine running. (-) * Solenoid-op. valves correctly connected electrically? Wheel, front left:term.2 Wheel, front right:term.35 Wheel, rear left:term.- Wheel, rear right:term.- Rear axle:term.18 (-) * Hydraulic modulator defective (-)
Operation pressure holding	1. Constantly press push-btn P= (upper ill.)	LED P= (upper ill.) lights up	
	2. Constantly press brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper ill.)	LED P= goes out (upper ill.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper ill.) lights up, wheel turnable by hand	
	5. Release push-button P arrow (upper ill.)	LED P arrow (upper ill.) goes out, wheel locks	
	6. Release brake pedal		

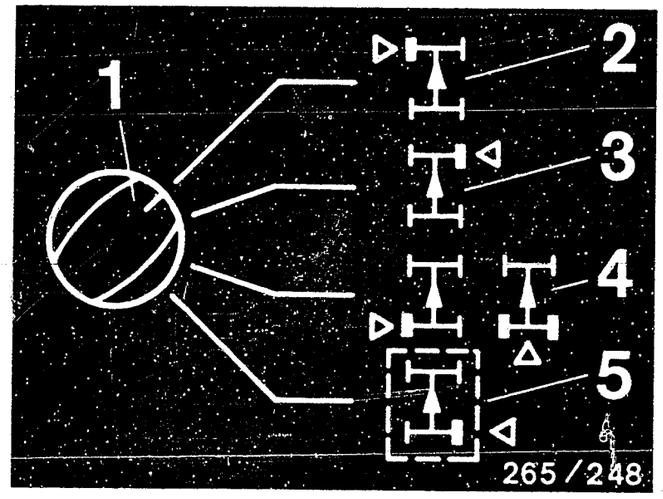


Rapid diagnosis chart (Continued 5)

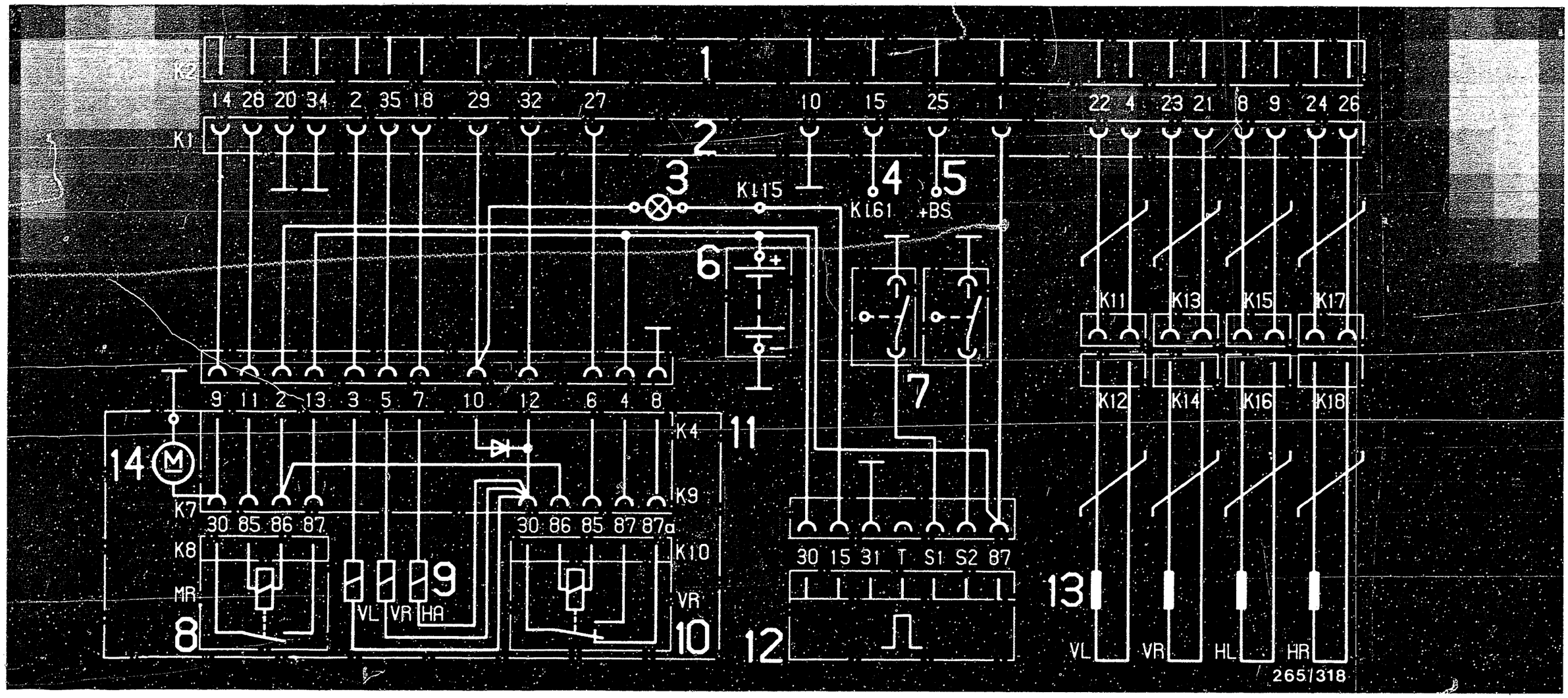
Program-selector-switch position 6 (4 wheel-speed sensor)

Test on (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of trouble (see coordinate)
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. (Wheel, front left: term.4 + term.22 Wheel, front right: term.23 + term.21 Wheel, rear left: term.8 + term.9 Wheel, rear right: term.24 + term.26	Chock up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 revolution per second). Afterwards read off reading at instrument: (upper illustration)	1. Smallest reading larger 1,6 divisions 2. Permissible fluctuation max. 25 % of greatest reading.	*Wheel-speed sensor lead mixed up (-) *Break in wheel-speed sensor lead (-) *Wheel-speed sensor defective(-) Winding resistance front axle: 0,8...1,8 k Ω rear axle: 0,8...1,8 k Ω *Air gap between wheel-speed sensor and ring gear too wide (-) *Ring gear defective or loose (-) *Ring gear with incorrect number of teeth installed: Front axle: (96) teeth Rear axle: (96) teeth (-) *Wheel-bearing clearance too large





Take for road test for final check. The warning lamp must go out when the engine is running. Drive at at least 30 km/h. The warning lamp must not light up again!



ELECTRICAL TERMINAL DIAGRAM

1 = Controller
2 = Controller plug (35-pin)
3 = ABS warning lamp
4 = to alternator
5 = to stop-lamp switch
6 = Battery
7 = Switch for differential locks
8 = Motor relay
9 = Solenoid-operated valves
10 = Valve relay
11 = Hydraulic modulator
12 = Combi relay
13 = Wheel-speed sensor
14 = Return supply-pump motor

VL = front left
VR = front right
HA = Rear axle
HL = rear left
HR = rear right
K1 to K22 = ABS plug connections

TEST EQUIPMENT AND TOOLS

Description	Designation	Part number
ABS2 LED tester	KDAS 0003	Procure. address: Robert Bosch GmbH KH/VKD 3 Postfach 41 09 60 7500 Karlsruhe 41
Adapter lead (included in scope of delivery of tester)	KDAS 0003/2	
Charging and bleeding device		e.g. ATE Part No. 3.9302-1000.4 1)
Bleeder fitting for connection of charging and bleeding device to fluid reservoir of brake master cylinder		ATE Part No. 3.9302.0702.2 1)
Bleeder hose		ATE Part No. 3.3590.2300.1 1)
Auxiliary hose		ATE Part No. 3.9302.0704.2 1)
Brake-pedal-actuating device		ATE Part No. 3.9312.0100.4 1)
Pressure tester Tester for low- and high-pressure testing, hydraulic brake systems		e.g. ATE Part No. 3.9305-0200.4 1)

TEST EQUIPMENT AND TOOLS (CONTINUED)

Designation	Code	Part number
Flat double-end flare nut wrench, 9 x 11 mm		Hazet Part No. 612 2)
Container, approx. 1 l for catching the brake fluid		
Brake fluid Use only DOT 4 or brake fluid from the vehicle manufacturer.		
Electrics tester or multimeter for trouble-shooting	ETE 014.00	0 684 101 400 Commercially available

Aid:
Use only original brake lines from the vehicle manufacturer!

Grease for wheel-speed sensor	Molykote Longterm 2
Protective caps for brake lines	1 900 508 002 (100 pieces)
Protective caps for brake-line connections at hydraulic modulator	1 900 508 004 (100 pieces)

1) obtainable from: Alfred Teves GmbH Guerickestr. 7
D-6000 Frankfurt (Main)

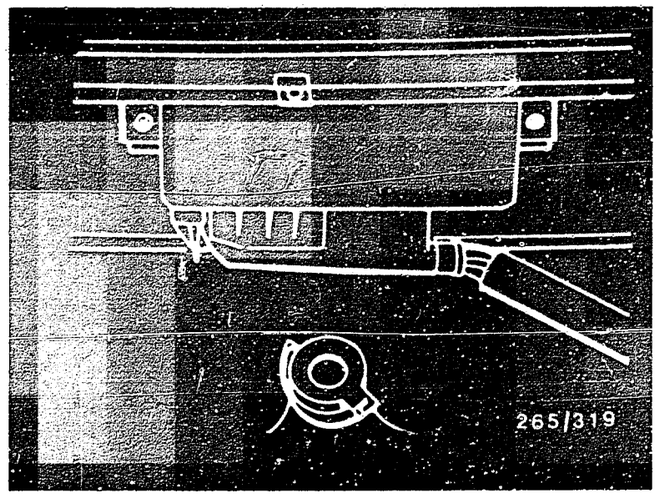
2) obtainable from: Hazet, D-5630 Remscheid

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

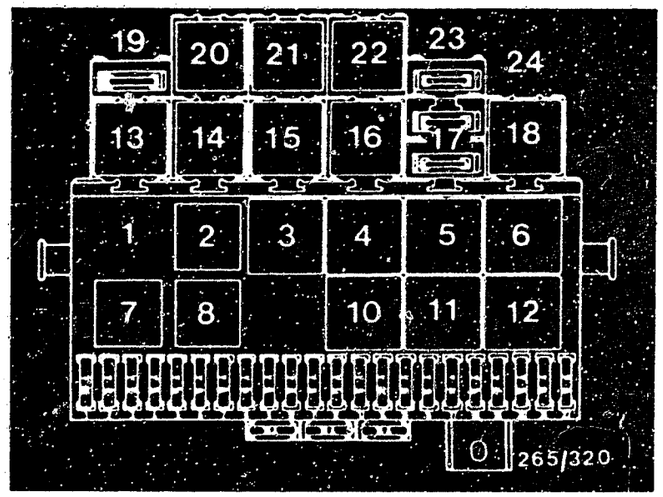
* ABS controller: (upper illustration)

  In trunk, rear right, behind the trunk panelling. To remove the controller, remove trunk panelling.



* Combi relay: (center illustration)

  In the fuse box, relay space 14



* ABS warning lamp:

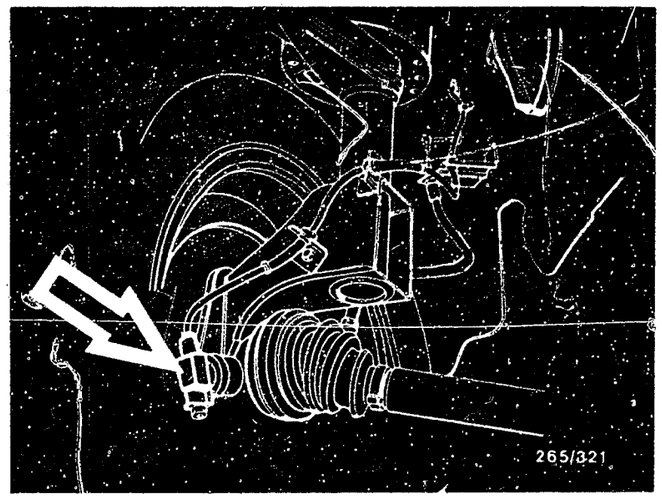
  In instrument panel.

* Wheel-speed sensor, front left: (lower illustration – arrow)

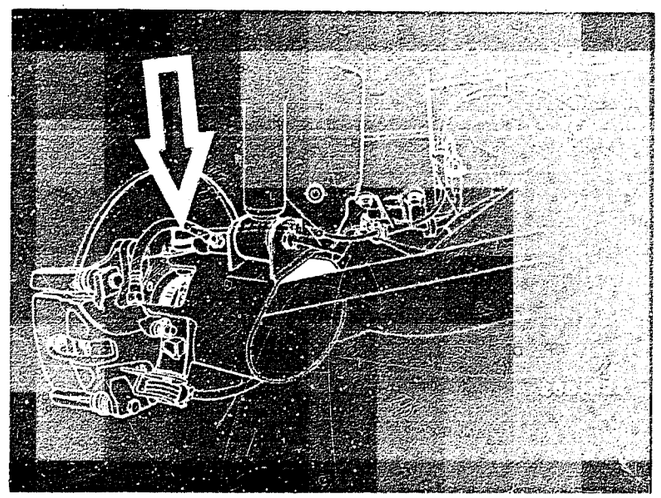
  Plug connection of wheel-speed sensor at left in engine compartment at McPherson strut dome.

* Wheel-speed sensor, front right:

  Plug connection of wheel-speed sensor at right in engine compartment between McPherson strut dome and battery



INSTALLATION POSITION OF COMPONENTS (CONTINUATION)



* Wheel-speed sensor, rear left: (upper illustration - arrow)

  Plug connection of wheel-speed sensor at left beneath rear seat bench.

* Wheel-speed sensor, rear right:

  Plug connection of wheel-speed sensor at right beneath rear seat bench.

* Hydraulic modulator:

  In engine compartment near to brake master cylinder

The hydraulic modulator must not be repaired, but be exchanged only as a complete unit.

<u>Exception:</u> Change of relay

GENERAL INFORMATION FOR REPAIRS AND ON BRAKE SYSTEM

The ABS is basically maintenance-free, however, when working on vehicles with ABS system the following must be noted:

1. When welding with electric welding equipment, pull plug from electronic controller.

2. When painting, the electronic controller may be loaded for a short time with max. +95°C and for a long time (approx. 2 hours) with max. +85°C.

3. After exchange of hydraulic modulator, controller, wheel-speed sensor and wiring harness, as well as after work in which the ABS units are touched (e.g. accident repairs), check the complete ABS system with the tester.
   Pay attention to correct assignment of brake lines and wheel-speed sensor connections to controller as well as wheel-speed sensor plug connections (see vehicle-specific terminal diagram).

4. Each time after working on the brake system, the latter must be bled and go through low-pressure and high-pressure tests. Test all junctions for leaks.

5. Tighten battery terminals securely to terminal posts of battery.

6. Do not use a fast charger for starting the engine.

7. Never disconnect the battery from the vehicle electrical system when engine is running.

8. When fast charging, disconnect the battery from the vehicle electrical system.

9. Take care that all connectors of the wiring harness are seated perfectly.

10. Never disconnect or connect the ABS wiring-harness plug from the controller when the ignition is switched on.

11. For reasons of safety, the hydraulic modulator must never be repaired, but be exchanged only as a complete unit.

    Excepted from this are the motor relay and the valve relay.
    Both relays may be exchanged.
    Apart from the brake-line connections, no screws at the hydraulic modulator may be loosened.
    Once they are loosened, it is impossible to make the brake circuits leak-free ever again!

There is d a n g e r t o l i f e !

Caution when handling brake fluid!

a) Fill brake fluid only into containers from which no one would mistakenly drink the fluid. (D a n g e r - p o i s o n o u s !)

b) Even slight traces of mineral oil leads to failure of the brake system. Take particular care with respect to colorless through to yellow-dyed brake fluid, since the danger of a mix-up is in this case greatest. If mineral oil is found in the brake system or there is suspicion of this being the case, thoroughly flush out the complete brake system with brake fluid. In addition, replace the main cylinder.

c) Do not allow brake fluid to come into contact with the vehicle paintwork, since the fluid contains elements which act as solvents for paint.

d) Brake fluid is highly hygroscopic, i.e. it absorbs moisture from the air, which lowers its boiling point. For this reason, store brake fluid only in well-sealed storage containers.

Note:

During the course of the service life of brake fluid, its boiling point drops through continuous absorption of moisture from the atmosphere. In the case of very high loading of the brakes, vapor bubbles may therefore develop in the brake system. Therefore, replace the brake fluid once a year, preferably in Spring.

For production reasons: continued on the following coordinate.

Trouble-shooting instructions : MB-5020

Bosch system : Electronic ignition (EI)

Vehicle make : MERCEDES-BENZ

Basic microcard : MB 523

Section — Coordinates

SPECIAL FEATURES

Mercedes Benz

230 GE engine 102.987 version ECE/KAT
Year of manuf. 1985, world-wide except USA, J, AUS
200 GE engine 102.964 version ECE/KAT
Year of manufacture 1986 Italy

Equipped with:

EI control unit 0 227 400 5..
(with current limiting)

or

Control unit from Siemens
(Daimler-Benz AG replacement part).

N o t e
Bosch and Siemens control units are interchangeable.

Ignition coil 0 221 5..

The ignition system in these vehicles corresponds to the basic microcard with the following auxiliary functions and special features:

* Adjustment plug with lettering 1-7 removed.

When referring to a basic microcard, note that the test specifications must always be taken from the vehicle-specific SIS brief instructions.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART

The rapid diagnosis chart starting on Coordinate F05 makes it possible for the experienced specialist to rapidly test the ignition system with the required test equipment and aids.

The rapid diagnosis chart contains test-step sequence, causes of defects, testing information, and test specifications.

Using the rapid diagnosis chart

Use the rapid diagnosis chart starting on Coordinate F05 if there is a primary signal or ignition spark.

Use the rapid diagnosis chart starting on Coordinate F09 if there is no primary signal or ignition spark.

Requirements for testing

Battery fully charged, fuel system in good order, engine in good mechanical order (e.g. compression etc.).

Ambient temperature or temperature of the ignition system 0° to 100° C (temperature exerts significant influence on measured values).

The ignition must be switched off before pulling plug connections.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
1	High-voltage side	Visual test, e.g. of ignition harness, distributor cap, etc., continuity test, ignition oscillogram.	———
2	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,3... 0,6 Ω 7,3...13,2 k Ω
3	High-voltage distributor setting	Engine cyl.1 TDC. Distributor rotor center points to housing marking.	———
4 *	Contact resistance	Test voltage-supply leads of EI control unit or primary circuit for contact resistance.	max. 0,3 Ω
5	Pressure sensor	Pull throttle-valve switch plug connection. Engine idle. Pull off EI control-unit vacuum hose. Read off spark advance. Connect EI control-unit vacuum hose. Read off spark advance.	Ignition timing ADVANCED
6	Coolant-temperature sensor	Disconnect plug connection for throttle-valve switch. Disconnect EI control-unit vacuum hose. Engine at operating temperature. Run engine at 3200 min $^{-1}$. Read off spark advance. Disconnect coolant-temperature sensor plug. Read off spark advance. After testing, connect coolant-temperature sensor plug.	Ignition timing RETARDED
7a	Spark advance	Vehicle W I T H O U T C A T A L Y T I C C O N V E R T E R. Disconnect EI control-unit vacuum hose. Disconnect throttle-valve switch plug connection. Engine at operating temperature, however < 95°C. 1) with adjustment plug DB replacement part no. 0 155 450 728 (lettering on front) 2) with adjustment plug DB replacement part no. 0 155 452 728 (lettering on front)	Adjustment-plug position "S" (PREMIUM FUEL) 1) 28...32° before TDC 2) 26...30° before TDC at 3200 min $^{-1}$ Adjustment-plug position "N" (REGULAR FUEL) 20...24° before TDC at 3200 min $^{-1}$

* Carry out only when engine not running.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
7b	Spark advance	Vehicle W I T H C A T A L Y T I C C O N V E R T E R. Disconnect EI control-unit vacuum hose. Disconnect throttle-valve switch plug connection. Engine at operating temperature, however < 95°C.	Adjustment-plug position "S" (PREMIUM FUEL) 23...27° before TDC at 3200 min^{-1} Adjustment-plug position "N" (REGULAR FUEL) 20...24° before TDC at 3200 min^{-1}
8	Throttle-valve switch idle contact	Disconnect KE-Jetronic control-unit plug. Resistance between EI control-unit plug term.2 and battery negative. Throttle-valve idle position. Throttle-valve full-throttle position.	 approx. 0 Ω (continuity) infinite Ω
9	Voltage supply, EI control unit and ignition coil	Engine idle. Voltage at diagnostic socket term.5 (+) and battery terminal (-)	12...14 V max. 1 V below U_B
10	Peak coil current cutoff	Ignition ON Voltage at diagnostic socket term.5 (+) and term.4 (-)	after approx. 1 s 0 V
11	EI control unit	Engine idle Primary voltage, ignition coil term.15 and term.1	280...360 V

RAPID DIAGNOSIS CHART (CONTINUED)

No primary signal or ignition spark

Test step	Possible cause of defect	Testing instructions	Test specifications
1	Pulse generator	Resistance between EI control-unit plug term. 7 and battery negative (insulation test)	infinite Ω
	Pulse generator	Resistance between EI control-unit plug term. 7 and term. 31d	680...1200 Ω
	Pulse generator	Start engine. Voltage (oscilloscope), EI control-unit plug term.7(+) and term.31d(-)	U_s > 1 V
2	Voltage supply, EI control unit	Ignition ON Voltage, EI control-unit plug term.15(+) and term.31(-)	Battery voltage
3	Voltage supply, primary circuit	Ignition ON Voltage, EI control-unit plug term.16(+) and term.31(-)	Battery voltage
4	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,3... 0,6 Ω 7,3...13,2 k Ω

Ignition coil, primary	0,3...0,6 Ω
Ignition coil, secondary	7,3...13,2 k Ω
High-voltage-distributor-setting	cyl. 1 TDC Ig. dist. marking
Contact resistance, supply leads for EI control unit / primary circuit	max. 0,3 Ω

Coolant-temperature sensor		
+ 20° C	2,1...2,9 k Ω
+ 30° C	1,4...2,0 k Ω
+ 80° C	280...370 Ω
+ 90° C	210...280 Ω
+ 100° C	160...215 Ω

Spark advance without vacuum
Engine at operating temperature, however < 95° C

Vehicles w i t h catalytic converter

Fuel	Adjustment plug EZL KAT (green)	Engine speed min $^{-1}$ or ° crankshaft before TDC
Premium unleaded	Position S	3200 23°...27°
Regular unleaded	Position N	3200 20°...24°

Vehicles w i t h o u t catalytic converter

Fuel	Adjustment plug EZL ECE (white)	Engine speed min $^{-1}$ or ° crankshaft before TDC
Premium unleaded/ leaded	Position S	3200 1) 28°...32° 2) 26°...30°
Regular unleaded/ leaded	Position N	3200 20°...24°

1) With adjustment plug,
DB replacement part no. 0 155 450 728

2) With adjustment plug,
DB replacement part no. 0 155 452 728

Adjustment-plug position with version

	EZL * ECE	EZL ** KAT
	S	1 = infinite Ω
	2	2 = 2,4 k Ω
	N	3 = 1,3 k Ω
	4	5 = 750 Ω
	5	5 = 470 Ω
	6	N = 220 Ω
	7	7 = 0 Ω

* Code color: white
** Code color: green

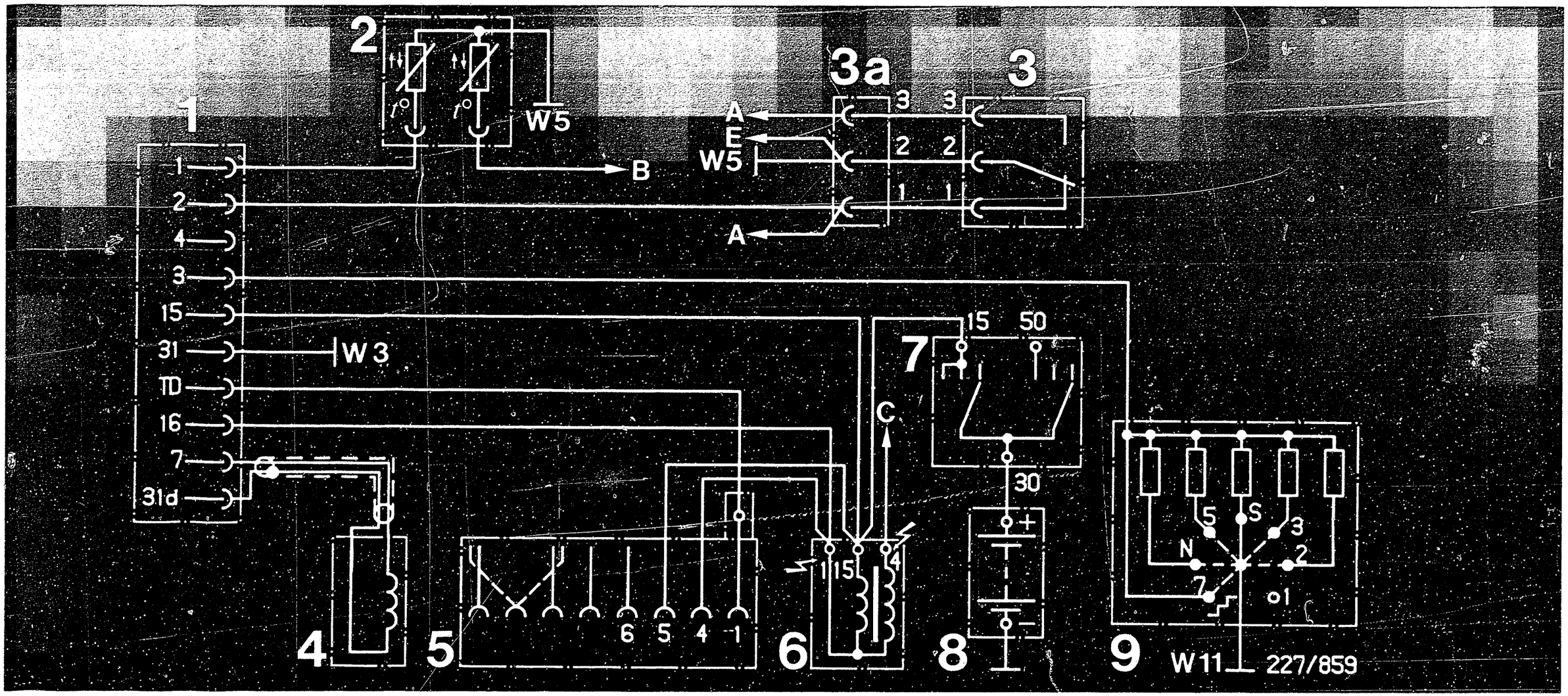
Voltage supply, EI control unit and ignition coil at engine idle speed	12...14 V max. 1 V below U_B

Throttle-valve switch idle contact

Idle-speed position	approx. 0 Ω (continuity)
Full-throttle position	infinite Ω

Peak coil current cutoff after approx. 1 s with ignition ON	0 V
Primary voltage at engine idle speed	280...360 V
Insulation of pulse generator	infinite Ω
Internal resistance of pulse generator	680...1200 Ω
Pulse-generator voltage at starting speed	U_s > 1 V
Voltage supply, EI control unit with ignition ON	U_B
Voltage supply, primary circuit with ignition ON	U_B

See Autodata test specifications for setting values for idle speed, exhaust, etc.

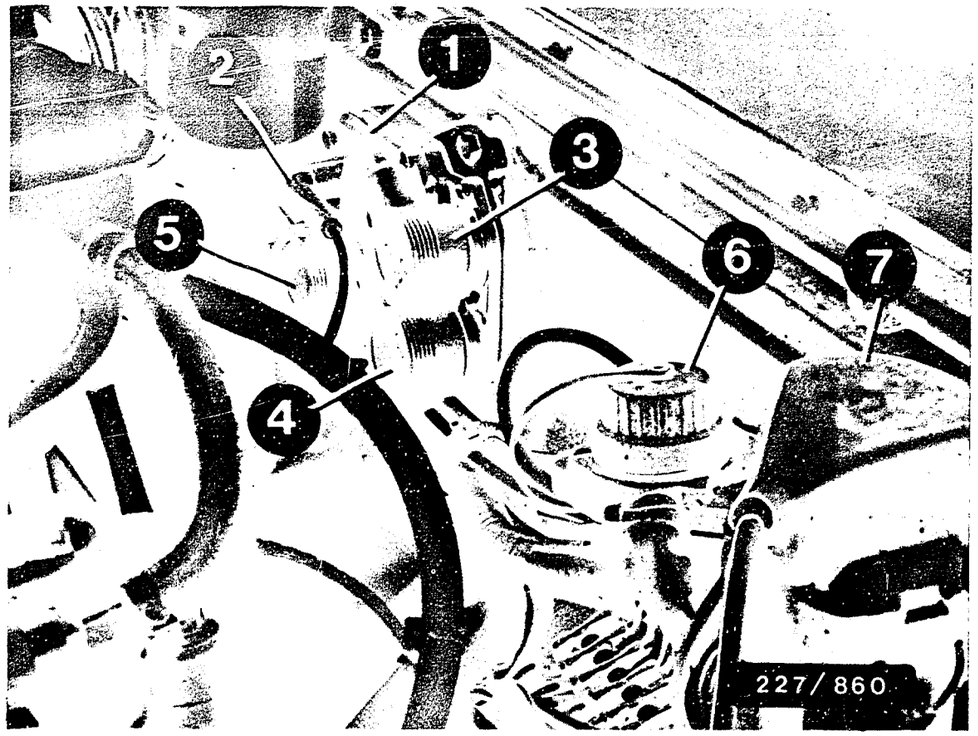


High-voltage arrows: Caution, 400 V...25 kV

1 = EI control unit
2 = Coolant-temperature sensor (double NTC)
3 = Throttle-valve switch
3a = Plug connection, throttle-valve switch
4 = Pulse generator
5 = Diagnostic socket
6 = Ignition coil
7 = Ignition and starting switch
8 = Battery
9 = Adjustment plug, lettering e.g. on EZL-KAT

A = To KE-Jetronic control unit
B = To KE-Jetronic control unit
C = To high-voltage distributor
E = To intake-air temperature sensor (KE-Jetronic)
W3 = Ground, wheel well
W5 = Ground, engine
W11 = Central ground

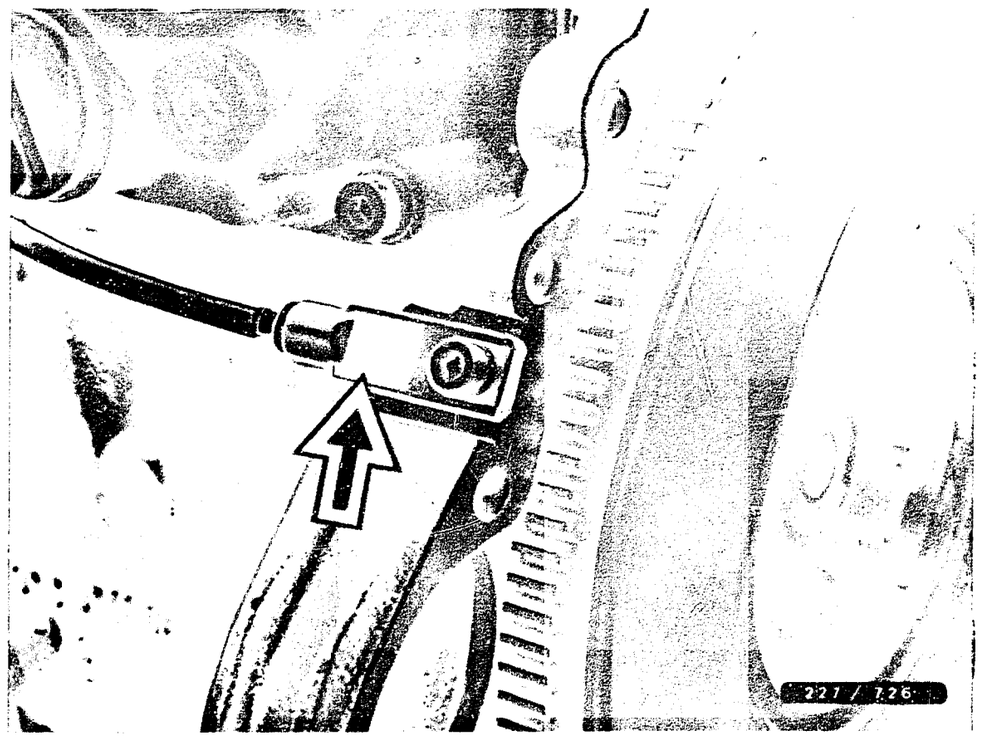
ELECTRICAL TERMINAL DIAGRAM



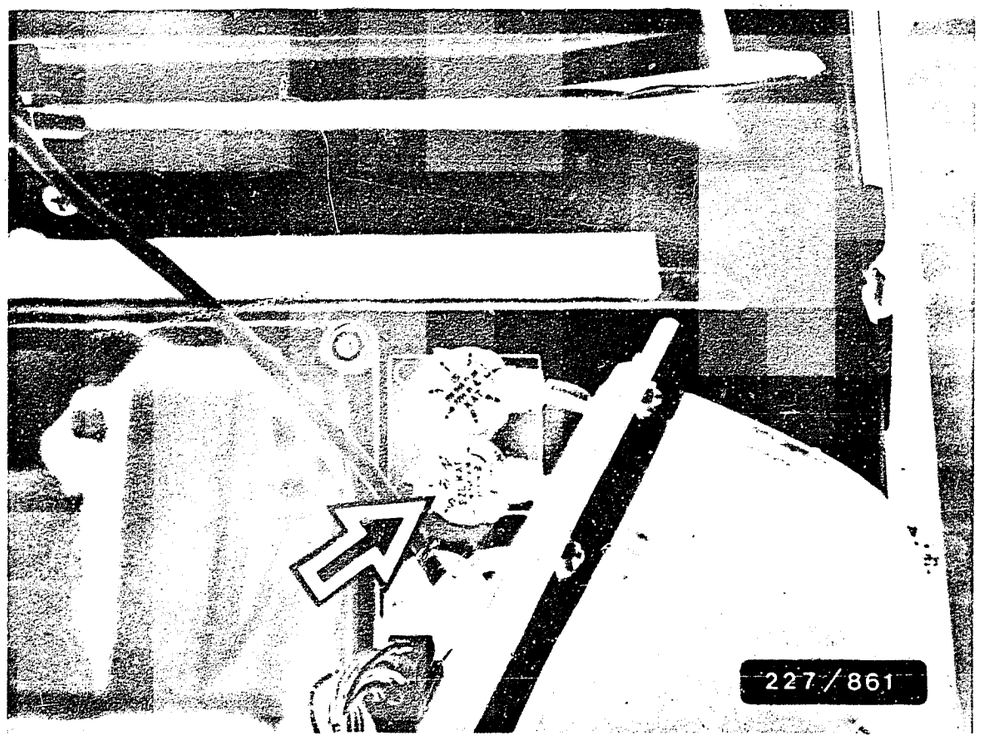
1 = EI control unt
2 = Vacuum hose
3 = 4–contact plug – supply
4 = 4–contact plug – sensor
5 = Coaxial plug – pulse generator
6 = Diagnostic socket
7 = Plastic ignition coil with protective hood

INSTALLATION POSITION OF COMPONENTS

The EI control unit, diagnostic socket, and ignition coil are located on the wheel well in the direction of travel.

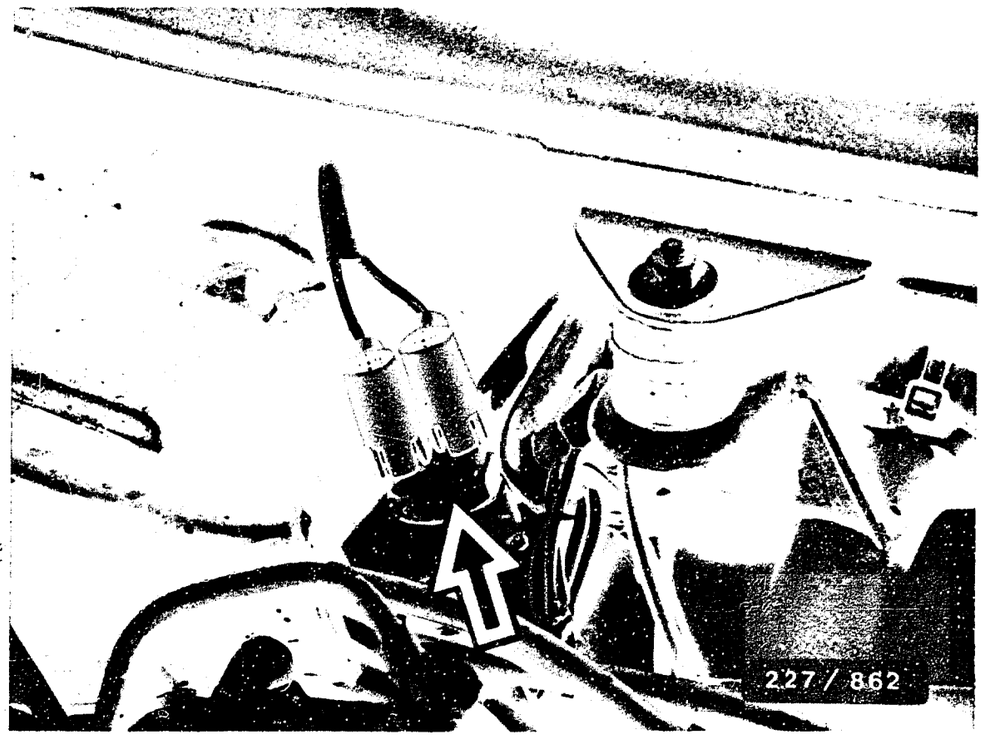


The pulse generator is located above the starting motor. See illustration, arrow.



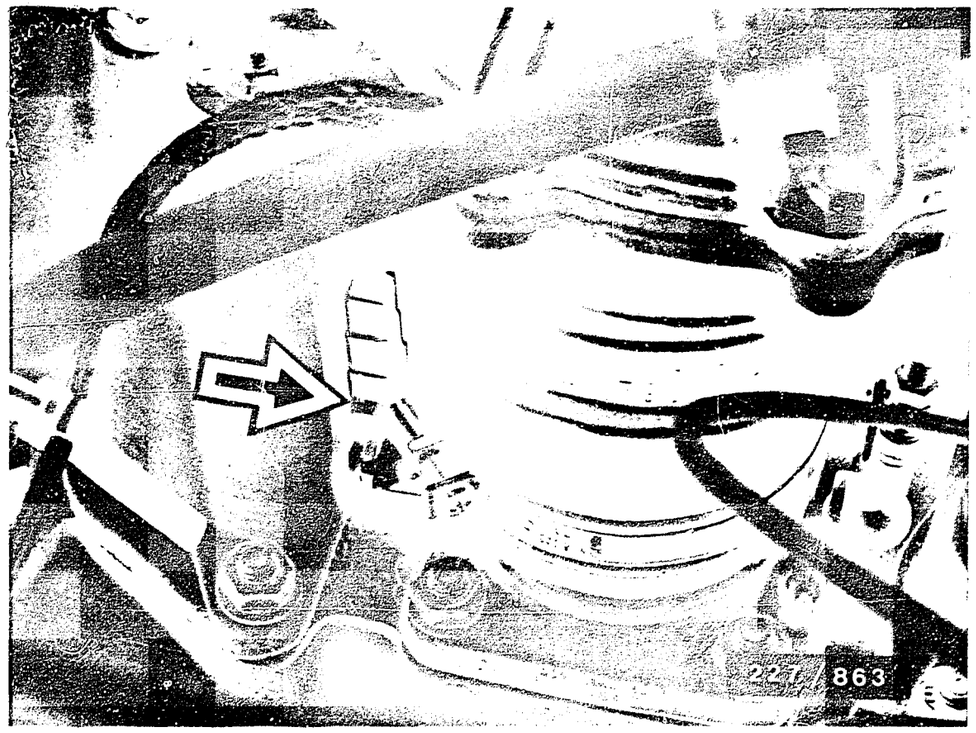
Arrow = Adjustment plug, ignition

The adjustment plug is located on the engine-compartment firewall.



Arrow = Coolant-temperature sensor (double NTC)

The coolant-temperature sensor is located on the cylinder head at the front (thermostat housing).



Arrow = Throttle-valve switch

The throttle-valve switch is located on the throttle-valve assembly.

For production reasons:
continued on the following coordinate.

Trouble-shooting instructions : MB-5021

Bosch system : Electronic ignition (EI)

Make of vehicle : MERCEDES BENZ

Basic microcard : MB 523

Section — Coordinates

SPECIAL FEATURES

Mercedes Benz

190 Engine 102.924 version ECE/CAT
200, 200 T Engine 102.922
version ECE/CAT / Year of manufacture 1986
worldwide except USA, Japan, Australia

Equipped with:
EI control unit 0 227 400 5..
(with current limitation)

or

EI control unit, Siemens
(Service part, Daimler Benz AG)

Note:
Bosch and Siemens control units are interchangeable.

Ignition coil 0 221 5..

The ignition system of these vehicles corresponds to the basic microcard with the following auxiliary functions or special features:

* Throttle-valve-switch idle contact not applicable.
  Idle signal (throttle-valve position) comes from Ecotronic control unit.

* Trimming plug with inscription 1-7 not applicable.

Note:
If reference is made to a basic microcard, always make sure you use the test specifications from the vehicle-specific brief instructions.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART

The rapid diagnosis chart starting on Coordinate G05 makes it possible for the experienced specialist to rapidly test the ignition system with the required test equipment and aids.

The rapid diagnosis chart contains test-step sequence, causes of defects, testing information, and test specifications.

Using the rapid diagnosis chart

Use the rapid diagnosis chart starting on Coordinate G05 if there is a primary signal or ignition spark.

Use the rapid diagnosis chart starting on Coordinate G09 if there is no primary signal or ignition spark.

Requirements for testing

Battery fully charged, fuel system in good order, engine in good mechanical order (e.g. compression etc.).

Ambient temperature or temperature of the ignition system 0° to 100° C (temperature exerts significant influence on measured values).

The ignition must be switched off before pulling plug connections.

RAPID DIAGNOSIS CHART (CONTINUATION)

Primary signal or ignition spark present

Test step	Possible cause of trouble	Test instructions	Test specifications
1	High-voltage end	Visual examination e.g. of ignition harness, distributor cap etc. continuity test, ignition oscillogram.	———
2	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,3... 0,6 Ω 7,3...13,2 k Ω
3	High-voltage distributor setting	Engine cyl.1 TDC. Distributor rotor center points to marking on housing.	———
4 *	Contact resistance	Check for contact resistance in voltage-supply leads of EI control unit and/or primary circuit.	max. 0,3 Ω
5	Pressure sensor	Disconnect EI control-unit plug (term.1 to term.4). Engine at idle. Disconnect vacuum hose, EI control unit. Read off spark advance. Connect vacuum hose, EI control unit. Read off spark advance.	Spark advance adjustment too ADVANCED
6	Coolant temperature sensor	Engine is at normal operating temperature. Disconnect EI control-unit plug (term.1 to term.4). Disconnect vacuum hose, EI control-unit plug. Run engine at idle. Read off spark advance. Connect EI control-unit plug term.1 and EI control-unit connection term.1 using auxiliary lead. Read off spark advance.	Spark advance adjustment too ADVANCED
7	Idle signal	Disconnect EI control-unit plug (term.1 to term.4). Engine at idle. Voltage, EI control-unit plug term.2 and battery negative. Accelerator pedal idle position. Slowly move accelerator pedal from idle position to part-load position. Note: If test specifications not O.K., test in accordance with SIS MB-530 (Ecotronic).	< 1 V > 8 V

* Only carry out when engine not running.

RAPID DIAGNOSIS CHART (CONTINUATION)

Primary signal or ignition spark present

Test step	Possible cause of trouble	Test instructions	Test specifications
8	Spark advance	Connect EI control-unit plug (term.1 to term.4). Disconnect vacuum hose, EI control unit. Engine at normal operating temperature, however, < 95°C.	Trimming-plug position "S" (PREMIUM FUEL) 22...26° before TDC at 3200 min^{-1} Trimming-plug position "N" (REGULAR FUEL) 15...19° before TDC at 3200 min^{-1}
9	Voltage supply, EI control unit and ignition coil	Engine at idle Voltage, diagnosis socket outlet term.5 (+) and battery terminal (−)	12...14 V max. 1 V below U_B
10	Peak coil current cutoff	Ignition ON Voltage, diagnosis socket outlet term.5 (+) and term.4 (−)	after approx.1 s 0 V
11	EI control unit	Engine at idle Primary voltage, ignition coil term.15 and term.1	280...360 V

RAPID DIAGNOSIS CHART (CONTINUED)

No primary signal or ignition spark

Test step	Possible cause of defect	Testing instructions	Test specifications
1	Pulse generator	Resistance between EI control-unit plug term. 7 and battery negative (insulation test)	infinite Ω
	Pulse generator	Resistance between EI control-unit plug term. 7 and term. 31d	680...1200 Ω
	Pulse generator	Start engine. Voltage (oscilloscope), EI control-unit plug term.7(+) and term.31d(−)	U_s > 1 V
2	Voltage supply, EI control unit	Ignition ON Voltage, EI control-unit plug term.15(+) and term.31(−)	Battery voltage
3	Voltage supply, primary circuit	Ignition ON Voltage, EI control-unit plug term.16(+) and term.31(−)	Battery voltage
4	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,3...0,6 Ω 7,3...13,2 k Ω

Ignition coil, primary	0,3... 0,6 Ω
Ignition coil, secondary	7,3...13,2 k Ω
High-voltage distributor setting	Cyl. 1 at TDC Ignition-distributor marking
Contact resistance, supply leads, EI control unit or primary circuit	max. 0,3 Ω

Idle signal with engine at idle

Accelerator idle position	< 1 V
Accelerator part-load position	> 8 V

Coolant temperature sensor

+ 20° C	2,1...2,9 k Ω
+ 30° C	1,4...2,0 k Ω
+ 80° C	280...370 Ω
+ 90° C	210...280 Ω
+ 100° C	160...215 Ω

Spark advance without vacuum
Engine at normal operating temperature, however, < 95° C

Vehicle w i t h o u t / w i t h catalytic converter

Fuel	Trimming plug EZL ECE (white)	Trimming plug EZL CAT (green)	Engine speed min $^{-1}$ or ° crank before TDC
Premium unleaded/leaded	Position S	Position S	3200 22–26°
Regular unleaded/leaded	Position N	Position N	3200 15–19°

Trimming-plug position for version

	EZL * ECE	EZL ** CAT
* Color code: white	S	1 = infinite Ω
** Color code: green	2	2 = 2,4 k Ω
	N	3 = 1,3 k Ω
	4	S = 750 Ω
	5	5 = 470 Ω
	6	N = 220 Ω
	7	7 = 0 Ω

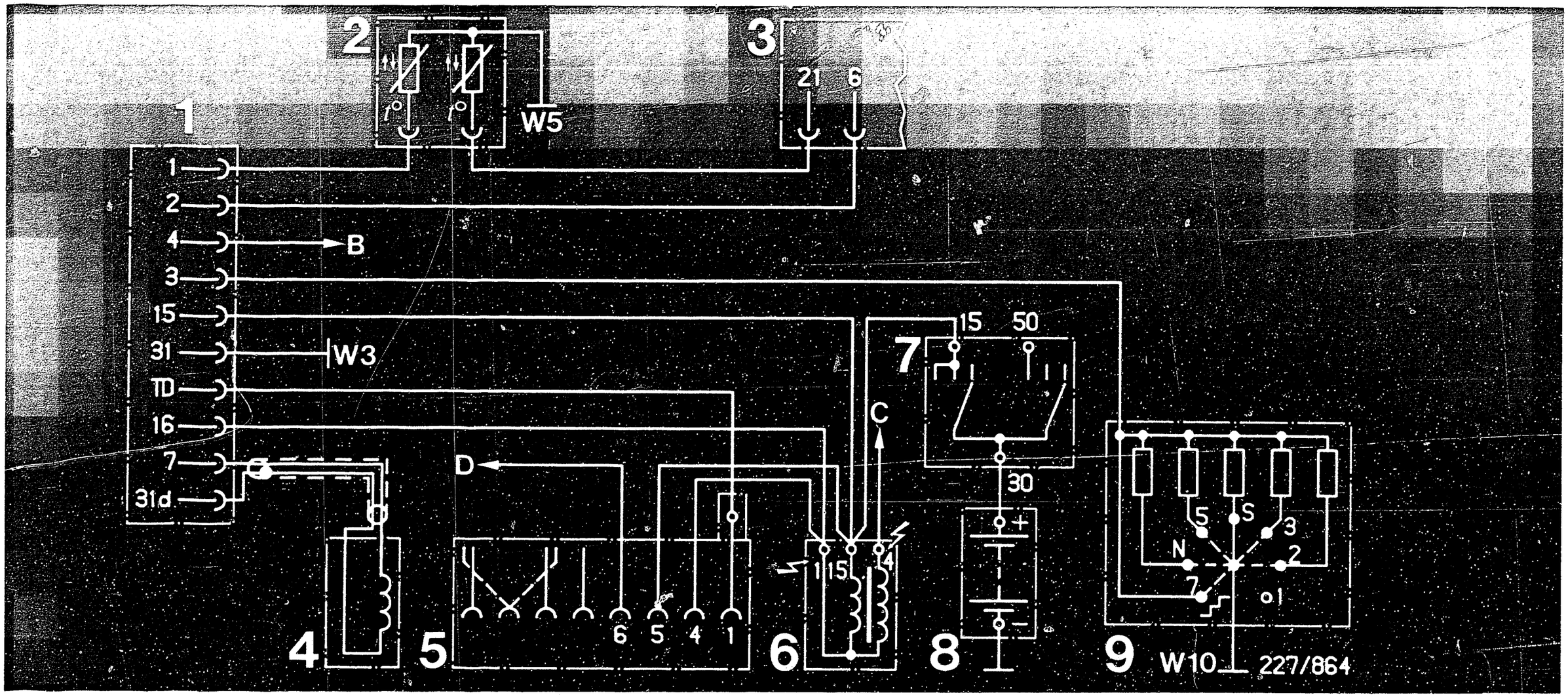
Voltage supply EI control unit and ignition coil with engine at idle	12...14 V max. 1 V below U_B

TEST SPECIFICATIONS (CONTINUATION)

Peak coil current cutoff after approx. 1 s with ignition ON	0 V
Primary voltage with engine at idle	280...360 V
Insulation, pulse generator	infinite Ω
Internal resistance pulse generator	680...1200 Ω
Voltage, pulse generator at starting speed	U_{s} > 1 V
Voltage supply, EI control unit with ignition ON	U_{B}
Voltage supply, primary circuit with ignition ON	U_{B}

See SIS MB-530 for settings for idle speed, exhaust-gas etc.

For production reasons: continued on the following coordinate.

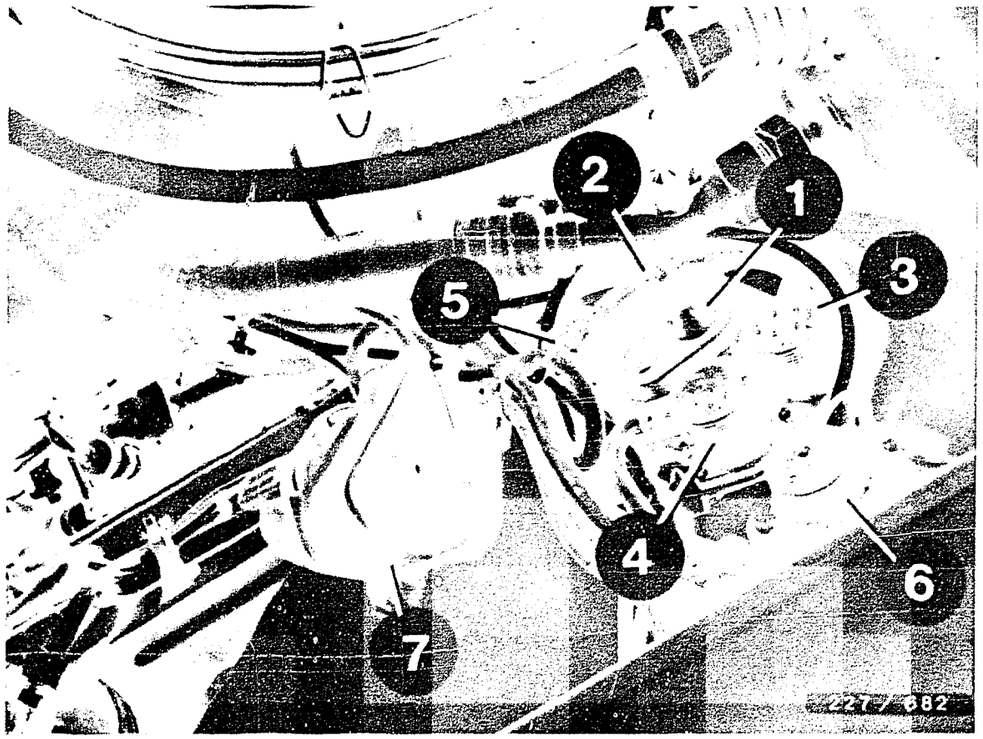


High-voltage arrows: Danger, 400 V...25 kV

1 = EI control unit
2 = Coolant temperature sensor (Double NTC)
3 = Ecotronic control unit
4 = Pulse generator
5 = Diagnosis socket outlet
6 = Ignition coil
7 = Ignition and starting switch
8 = Battery
9 = Trimming plug
Inscription e.g. EZL-CAT

B = without function, lead ends in cable set
C = to high-voltage distributor
D = Plug connection, engine (term. 30)
W3 = Ground, wheel house, front left (ignition coil)
W5 = Ground, engine
W10= Ground, battery

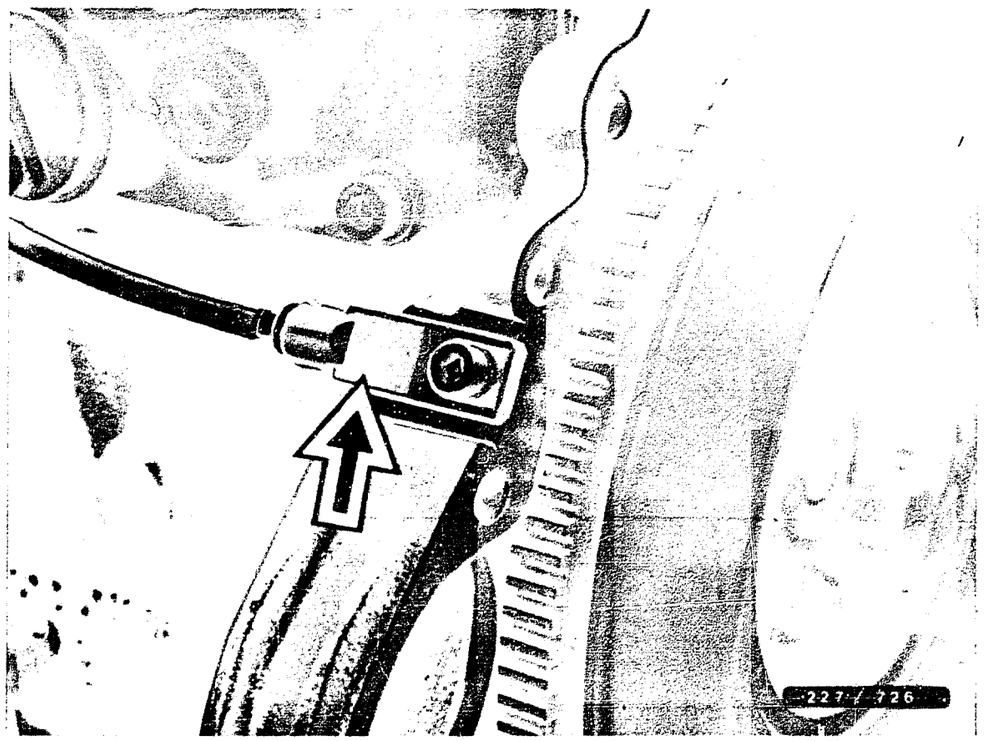
ELECTRICAL TERMINAL DIAGRAM



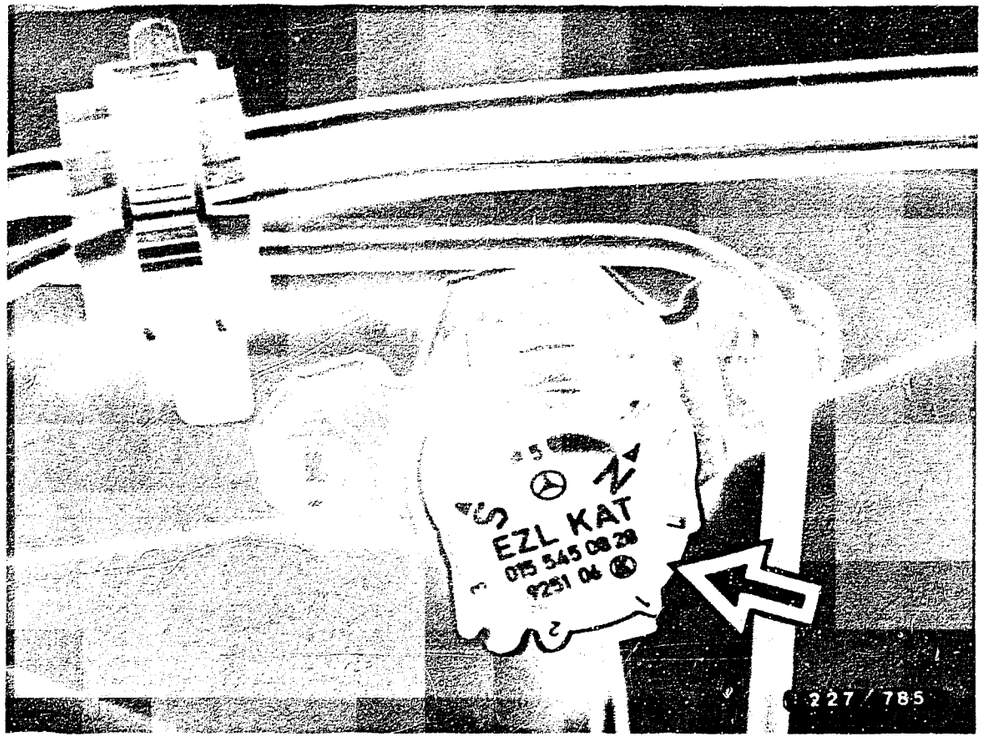
1 = EI control unit e.g. vehicle type 124
2 = Vacuum hose
3 = Quadruple plug – Supply
4 = Quadruple plug – Sensor
5 = Coaxial plug – Pulse generator
6 = Diagnosis socket outlet
7 = Plastic ignition coil with protective cover

INSTALLATION POSITION OF COMPONENTS

EI control unit, diagnosis socket outlet and ignition coil are positioned at the wheel house on the left-hand side (as seen from forward direction of travel).



The pulse generator is located above the starting motor. See illustration, arrow.



Arrow = Trimming plug, ignition
e.g. vehicle type 124

Trimming plug is positioned at the partitioning wall of the engine compartment (near to brake master cylinder or fuse box).

Arrow = Coolant-temperature sensor
(double NTC)

The coolant-temperature sensor is located on the cylinder head at the front (thermostat housing).

T A B L E O F C O N T E N T S

Trouble-shooting instructions : MB-5022

Bosch system : Electronic ignition (EI)

Vehicle make : MERCEDES-BENZ

Basic microcard : PKW-022

1.Special features

Mercedes-Benz

420 SE, SEL, SEC, SL Engine 116.964/965
Version ECE/KAT

500 SE, SEL, SEC, SL Engine 117.964/965
Version ECE/KAT

Year of manufacture 1985 world-wide except USA/Japan/Australia

Equipped with:
EI control unit 0 227 400 6..
(with current limiting)

or

EI control unit from Siemens
(Daimler-Benz AG replacement part)

Note:
Bosch and Siemens control units are interchangeable.
Ignition coil 0 221 5..

The ignition system in these vehicles corresponds to the basic microcard with the following auxiliary functions and special features:

* Without transmission-overload protection

* Without maximum speed limitation

Note:
When referring to a basic microcard, note that the test specifications must always be taken from the vehicle-specific SIS brief instructions.

For production reasons:
continued on the following coordinate.

RAPID DIAGNOSIS CHART

The rapid diagnosis chart starting on Coordinate H05 makes it possible for the experienced specialist to rapidly test the ignition system with the required test equipment and aids.

The rapid diagnosis chart contains test-step sequence, causes of defects, testing information, and test specifications.

Using the rapid diagnosis chart

Use the rapid diagnosis chart starting on Coordinate H05 if there is a primary signal or ignition spark.

Use the rapid diagnosis chart starting on Coordinate H09 if there is no primary signal or ignition spark.

Requirements for testing

Battery fully charged, fuel system in good order, engine in good mechanical order (e.g. compression etc.).

Ambient temperature or temperature of the ignition system 0° to 100° C (temperature exerts significant influence on measured values).

The ignition must be switched off before pulling plug connections.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
1	High-voltage side	Visual test, e.g. of ignition harness, distributor cap, etc., continuity test, ignition oscillogram.	———
2	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,2...0,4 Ω 7,3...13,2k Ω
3	High-voltage distributor setting	Engine cyl. 1 TDC. Distributor-rotor center points to housing marking.	———
4 *	Contact resistance	Test voltage-supply leads of EI control unit or primary circuit for contact resistance.	max. 0,3 Ω
5	Pressure sensor	Disconnect EI control-unit vacuum hose. Operate engine at 2000 min $^{-1}$. Read off spark advance. Re-connnect EI control-unit vacuum hose. Operate engine at 2000 min $^{-1}$. Read off spark advance.	Ignition timing ADVANCED
6	Coolant-temperature sensor	Disconnect EI control-unit vacuum hose. Operate engine (at operating temperature) at 2000 min $^{-1}$. Read off spark advance. Disconnect both coolant-temperature sensor plugs. Operate engine at 2000 min $^{-1}$. Read off spark advance. After testing, re-connect coolant-temperature sensor plugs.	Ignition timing ADVANCED
7	Spark advance	Vehicle W I T H C A T A L Y T I C C O N V E R T E R . Disconnect EI control-unit vacuum hose. Disconnect throttle-valve switch plug connection. Engine at operating temperature, however < 95°C.	Adjustment-plug position "S" (PREMIUM FUEL) 28...32° before TDC at 3500 min $^{-1}$ Adjustment-plug position "N" (REGULAR FUEL) 22...26° before TDC at 3500 min $^{-1}$

* Carry out only when engine not running.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
7 a	Spark advance	Vehicle W I T H O U T C A T A L Y T I C C O N V E R T E R . Disconnect EI control-unit vacuum hose. Disconnect throttle-valve switch plug connection. Engine at operating temperature, however < 95°C	Adjustment-plug position "S" (PREMIUM FUEL) 27...31° before TDC at 3500 min $^{-1}$ Sweden/Switzerland 28...32° before TDC Adjustment-plug position "N" (REGULAR FUEL) 21...25° before TDC at 3500 min $^{-1}$ Sweden/Switzerland 22...26° before TDC
8	Throttle-valve switch, full-load contact and leads	Disconnect throttle-valve switch plug connection. Resistance, throttle-valve switch plug connection term.2 and term.3 (throttle-valve side) — Throttle-valve idle position : Throttle-valve full-throttle position : Disconnect EI control-unit plug. Resistance of throttle-valve switch plug connection term.3 or term.2 (wiring-harness side) to EI control-unit plug term.2 or battery negative.	 infinite Ω approx. 0 Ω approx. 0 Ω (continuity)
9 9	Voltage supply, EI control unit and ignition coil	Engine idle Voltage at diagnostic socket term.5 (+) and battery terminal (–)	12...14 V max. 1 V below U_B
10	Peak coil current cutoff	Ignition ON Voltage at diagnostic socket term.5 (+) and term.4 (–)	after approx. 1 s 0 V
11	EI control unit	Engine idle Primary voltage, ignition coil term.15 and term.1	280...360 V

RAPID DIAGNOSIS CHART (CONTINUED)

No primary signal or ignition spark

Test step	Possible cause of defect	Testing instructions	Test specifications
1	Pulse generator	Resistance between EI control-unit plug term.7 and battery negative (insulation test)	infinite Ω
	Pulse generator	Resistance between EI control-unit plug term.7 and term.31d	680...1200 Ω
	Pulse generator	Start engine. Voltage (oscilloscope), EI control-unit plug term.7(+) and term.31d(−)	U_s > 1 V
2	Voltage supply, EI control unit	Ignition ON Voltage, EI control-unit plug term.15(+) and term.31(−)	Battery voltage
3	Voltage supply, primary circuit	Ignition ON Voltage, EI control-unit plug term.16(+) and term.31(−)	Battery voltage
4	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,2...0,4 Ω 7,3...13,2 k Ω

Ignition coil, primary	0,2...0,4 Ω
Ignition coil, secondary	7,3...13,2 k Ω
High-voltage-distributor-setting	cyl. 1 TDC Ig. dist. marking
Contact resistance, supply leads for EI control unit / primary circuit	max. 0,3 Ω
Coolant-temperature sensor	
+ 20 C	2,1...2,9 k Ω
+ 30 C	2,4...2,0 k Ω
+ 80 C	280...370 Ω
+ 90 C	210...280 Ω
+ 100 C	160...215 Ω

Spark advance without vacuum, engine at operating temperature, however < approx. 95°C

Vehicle W I T H catalytic converter

Fuel	Adjustment plug EZL KAT (green)	Engine speed min $^{-1}$ or ° crankshaft before TDC
Premium unleaded	Position S	3500 28...32
Regular unleaded	Position N	3500 22...26

Vehicles W I T H O U T catalytic converter

Fuel	Adjustment plug EZL ECE (white)	Engine speed min $^{-1}$ ° crankshaft before TDC
Premium unleaded/ leaded	Position S	3500 27...31 28...32 *
Regular unleaded/ leaded	Position N	3500 21...25 22...26 *

* Sweden/Switzerland only

Adjustment-plug position with version

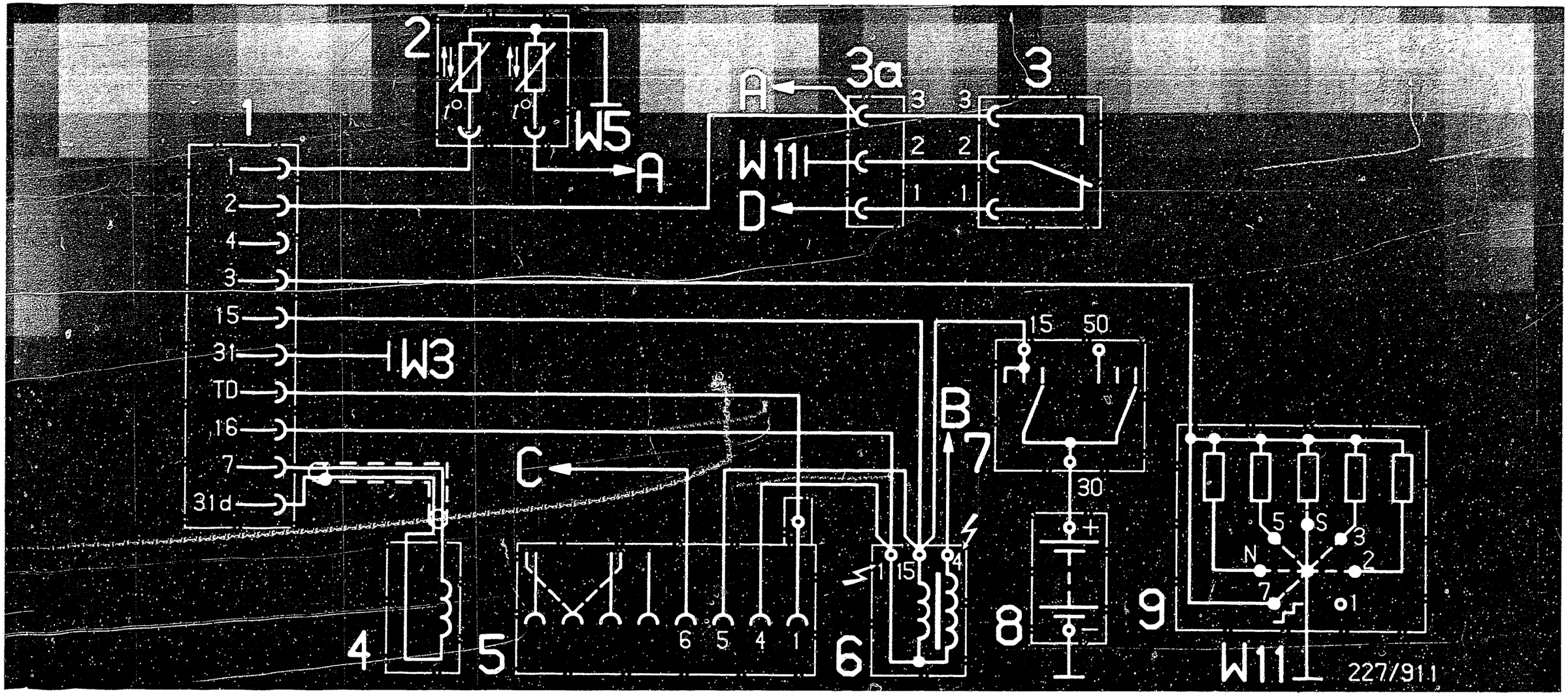
ECE *	KAT **
S	1 = infinite Ω
2	2 = 2,4k Ω
N	3 = 1,3k Ω
4	S = 750 Ω
5	5 = 470 Ω
6	N = 220 Ω
7	7 = 0 Ω

* Code color: white
** Code color: green

Throttle-valve switch, full-load contact	
Idle position	infinite Ω
Full-throttle position	approx. 0 Ω
Voltage supply, EI control unit and ignition coil at engine idle	12...14 V max. 1 V below U_B
Peak coil current cutoff after approx. 1s with ignition ON	0 V
Primary voltage at engine idle speed	280...360 V
Insulation of pulse generator	infinite Ω
Internal resistance of pulse generator	680...1200 Ω
Pulse-generator voltage at starting speed	U_s > 1 V

Voltage supply, EI control unit with ignition ON	U_B
Voltage supply, primary circuit with ignition ON	U_B

See Jetronic SIS microcard or Autodata test specifications for setting values for idle speed, exhaust, etc.



High-voltage arrows: Caution, 400 V...25 kV

1 = EI control unit
2 = Coolant-temperature sensor (double NTC)
3 = Throttle-valve switch
3a = Plug connection, throttle-valve switch
4 = Pulse generator
5 = Diagnostic socket
6 = Ignition coil
7 = Ignition and starting switch
8 = Battery
9 = Adjustment plug, lettering e.g. on EZL-KAT

A = To KE-Jetronic control unit
B = To high-voltage distributor
C = To fuse 2 term. 30
D = To control unit, idle-speed control
W3 = Ground, front left wheel well (ignition coil)
W5 = Ground, engine
W11= Ground, engine (electrical lead screwed on)

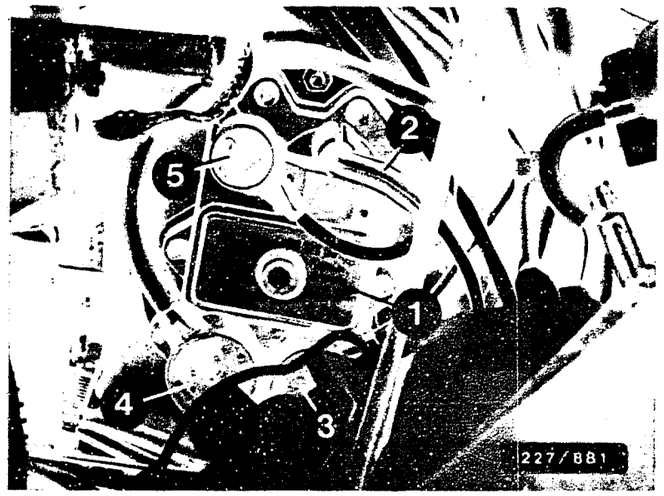
ELECTRICAL TERMINAL DIAGRAM

H15 ⟹

H16 ⟸

INSTALLATION POSITION OF COMPONENTS

The EI control unit is located on the front left wheel well on vehicle type 126, and on the front left side member (near headlamp) on vehicle type 107.



1 = EI control unit, vehicle type 126
2 = Vacuum hose
3 = 4-contact plug - supply
4 = 4-contact plug - sensor
5 = Coaxial plug - pulse generator

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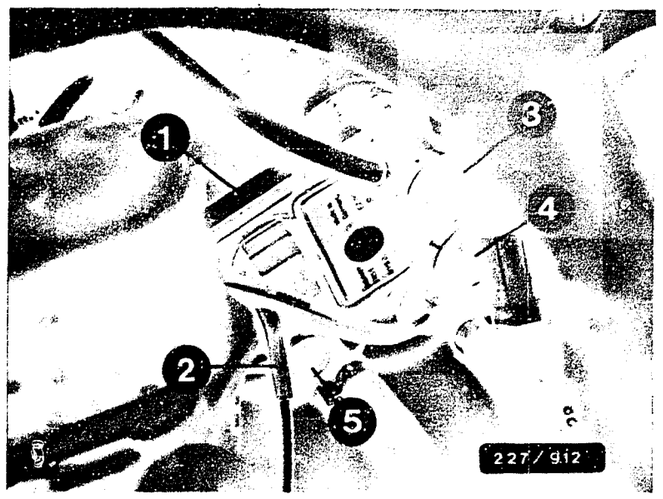
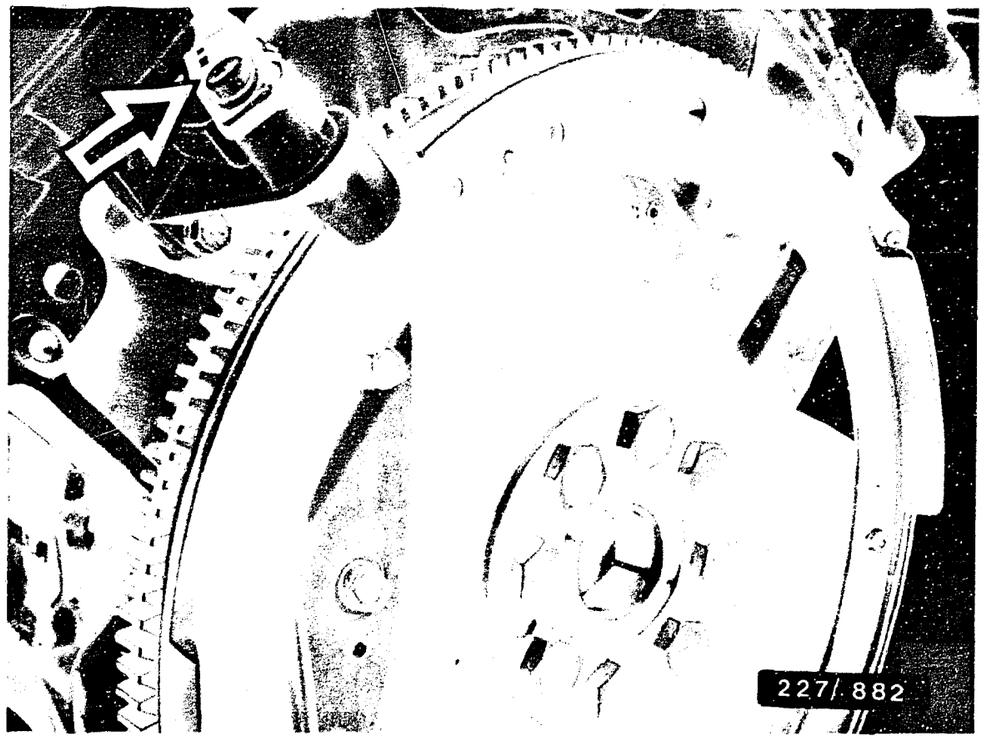
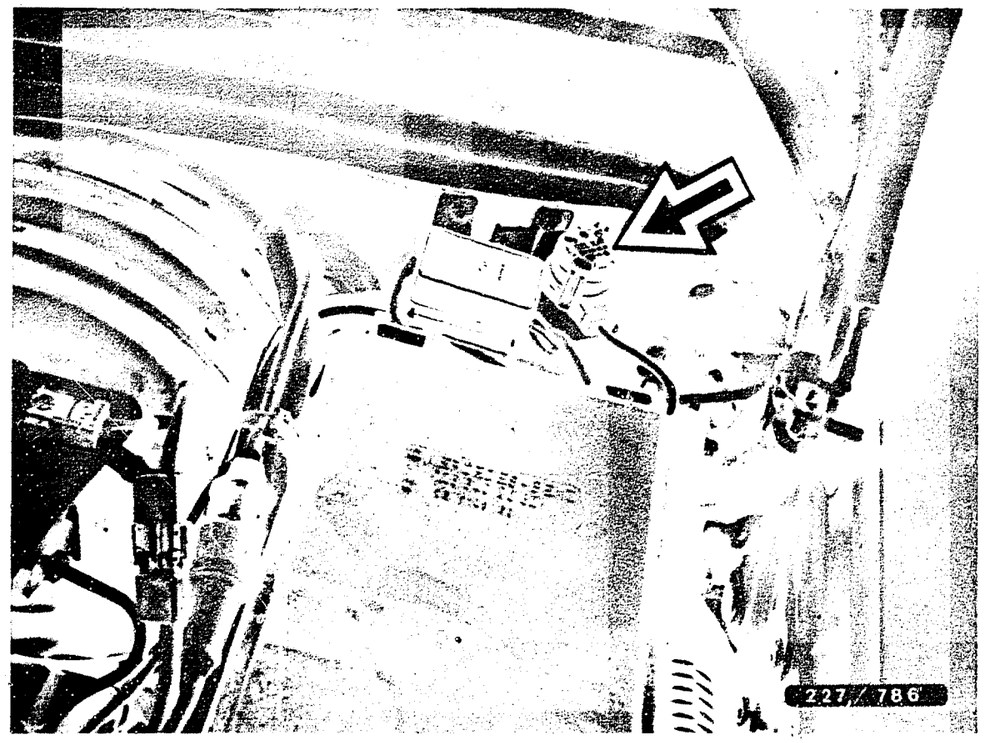
1 = EI control unit, vehicle type 107
2 = Vacuum hose
3 = 4-contact plug - supply
4 = 4-contact plug - sensor
5 = Coaxial plug - pulse generator



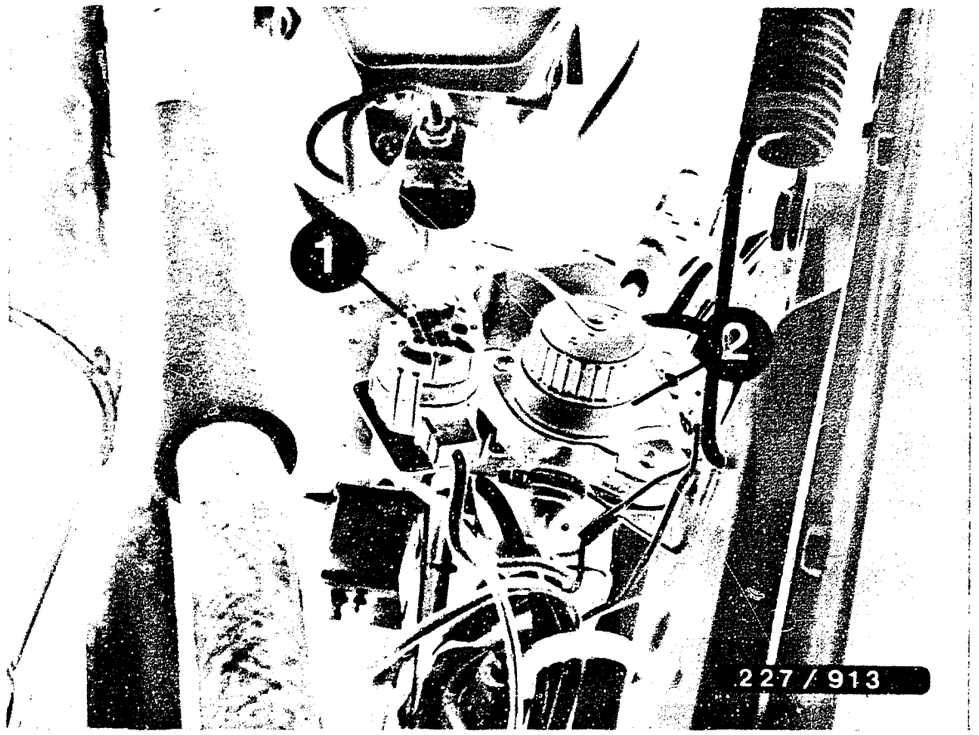


Arrow = Pulse generator

The pulse generator is located on the engine block on left in direction of travel.

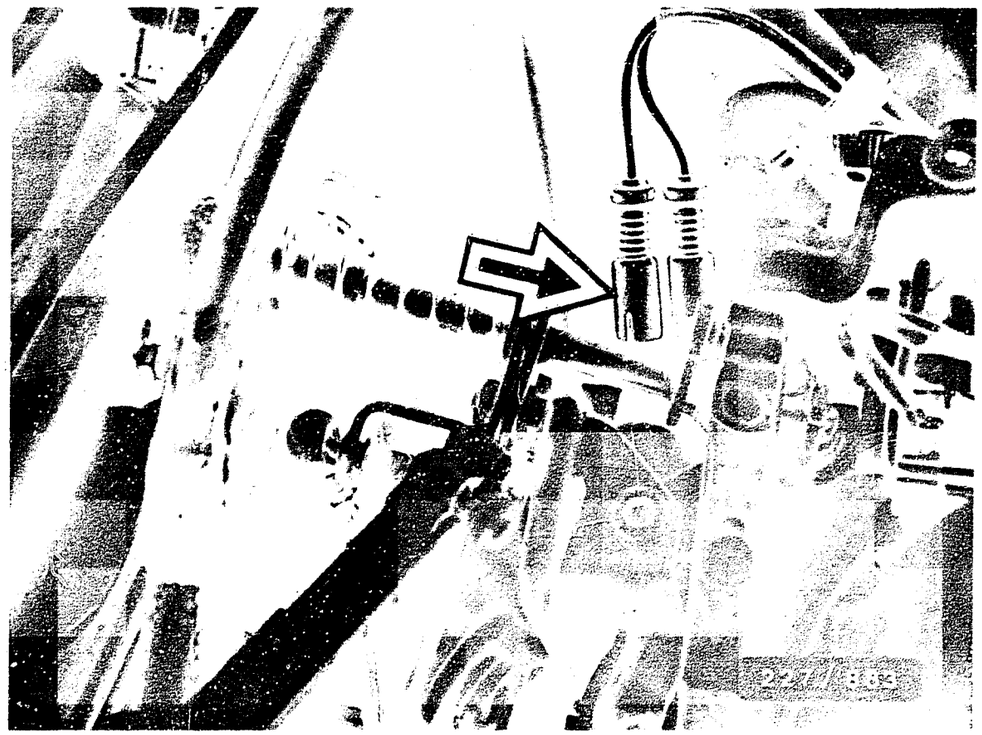


Arrow = Adjustment plug, ignition, vehicle type 126



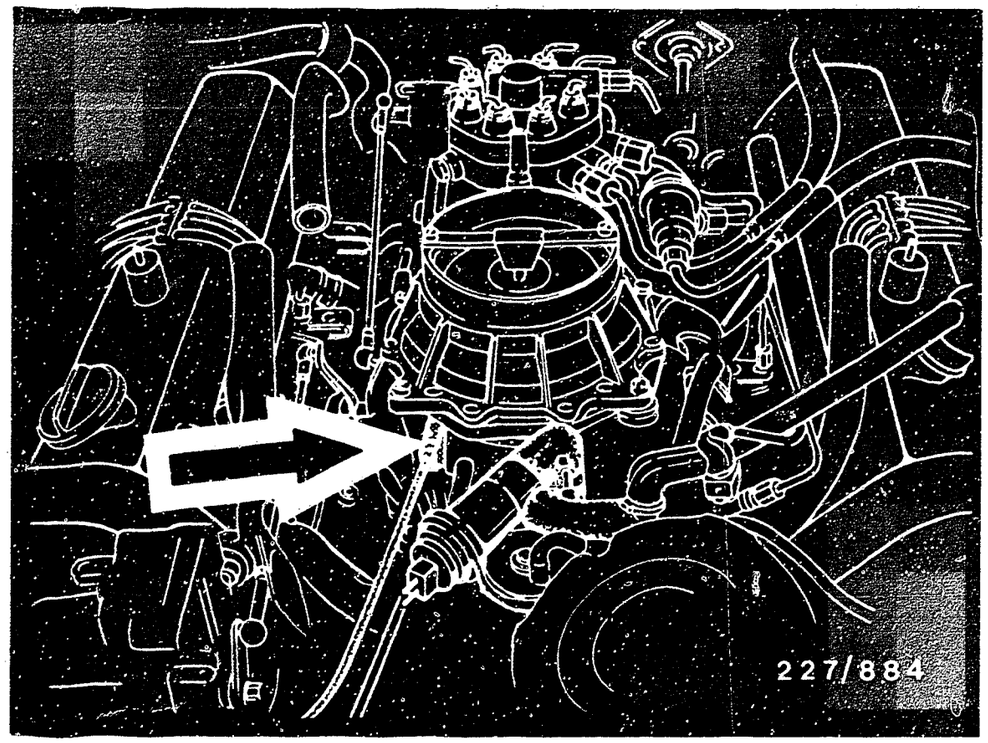
1 = Adjustment plug, vehicle type 107
2 = Diagnostic socket

The adjustment plug is located near the brake master cylinder.



Arrow = Coolant—temperature sensor (double NTC)

The coolant temperature sensor (green/black lead) is located on the cylinder head, rear left.



Arrow = Throttle-valve switch

The throttle-valve switch is located on the throttle-valve assembly.

H23

For production reasons:
continued on the following coordinate.

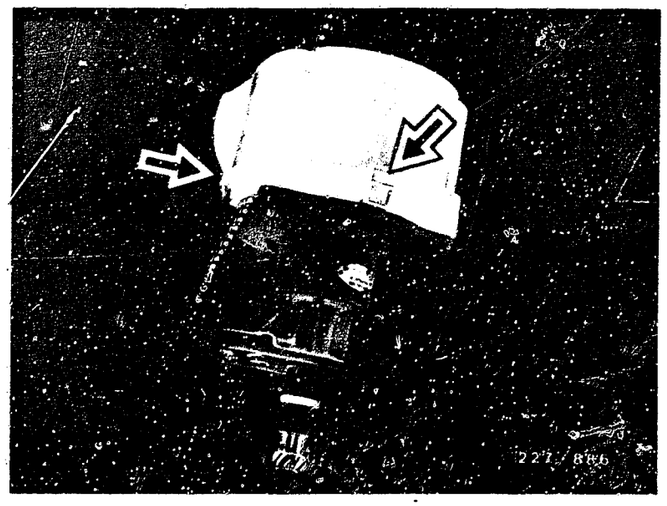
H24

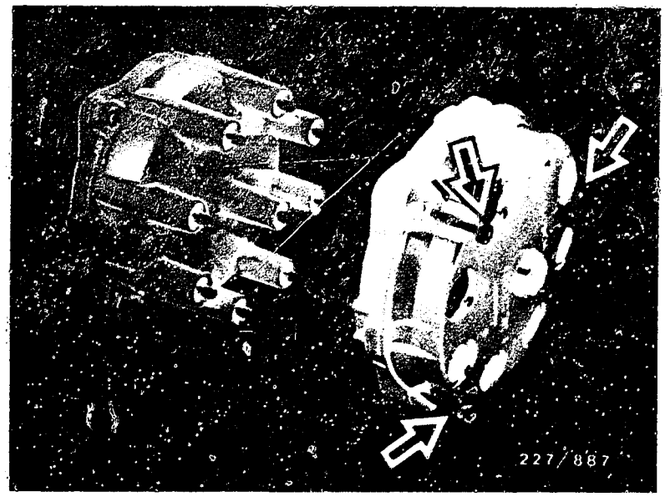
High-voltage distributor, see upper illustration

Instructions for removal:

To remove the hood, unclip the 3 straps (arrows, middle illustration) and pull hood upwards.

The distributor cap is screwed on to the high-voltage distributor with special screws (arrows, lower illustration) together with the protective cap for long-distance interference suppression.





T A B L E O F C O N T E N T S

Trouble-shooting instructions : MB-5023

Bosch system : Electronic ignition (EI)

Vehicle make : MERCEDES-BENZ

Basic microcard : PKW-022

SPECIAL FEATURES

Mercedes-Benz

420 SE/ SEL/ SEC/ SL engine 116.965
560 SE/ SEL/ SEC/ SL engine 117.968
Year of manufacture 1985 USA/Japan/Australia

Equipped with:
EI control unit 0 227 400 6..
(with current limiting)

or

EI control unit from Siemens
(Daimler-Benz AG replacement part).

Note:

Bosch and Siemens control units are interchangeable.

Ignition coil 0 221 5..

The ignition system in these vehicles corresponds to the basic microcard with the followig auxiliary functions and special features:

* No transmission-overload protection
* No maximum speed limiting
* Adjustment plug without ignition-point adaptation

Note:

When referring to a basic microcard, note that the test specifications must always be taken from the vehicle-specific SIS brief instructions.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART

The rapid diagnosis chart starting on Coordinate J05 makes it possible for the experienced specialist to rapidly test the ignition system with the required test equipment and aids.

The rapid diagnosis chart contains test-step sequence, causes of defects, testing information, and test specifications.

Using the rapid diagnosis chart

Use the rapid diagnosis chart starting on Coordinate J05 if there is a primary signal or ignition spark.

Use the rapid diagnosis chart starting on Coordinate J09 if there is no primary signal or ignition spark.

Requirements for testing

Battery fully charged, fuel system in good order, engine in good mechanical order (e.g. compression etc.).

Ambient temperature or temperature of the ignition system 0° to 100° C (temperature exerts significant influence on measured values).

The ignition must be switched off before pulling plug connections.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal and/or ignition spark available

Test step	Possible cause of trouble	Test instructions	Test specifications
1	High-voltage end	Visual examination e.g. of ignition harness, distributor cap etc. continuity test, ignition oscillogram.	———
2	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,2...0,4 Ω 7,3...13,2 k Ω
3	High-voltage distributor setting	Engine cyl. 1 at TDC. Distributor rotor center points to housing marking.	———
4 *	Contact resistance	Check for contact resistance in voltage-supply leads of EI control unit and/or primary circuit.	max. 0,3 Ω
5	Pressure sensor	Disconnect vacuum hose, EI control unit. Run engine at 2000 min^{-1} . Read off spark advance. Connect vacuum hose, EI control unit. Run engine at 2000 min^{-1} . Read off spark advance.	Spark advance ADVANCED
6	Coolant temperature sensor	Disconnect vacuum hose, EI control unit. Run engine (norm. op. temp.) at 2000 min^{-1} . Read off spark advance. Disconnect both coolant temperature sensor plugs. Run engine at 2000 min^{-1} . Read off spark advance. After testing, connect coolant temperature sensor plug.	Spark advance RETARDED
7	Spark advance	Disconnect vacuum hose, EI control unit. Disconnect throttle-valve switch plug connection. Engine at normal operating temperature, however, < 95°C.	420 SE/SEL/SEC/SL USA/JAPAN with PREMIUM FUEL 28...32° before TDC at 3500 min^{-1} REGULAR FUEL Australia 22...26° before TDC at 3500 min^{-1}

* Only perform when engine not running.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
7a	Spark advance	Disconnect EI control-unit vacuum hose. Disconnect throttle-valve switch plug connection. Engine at operating temperature, however < 95°C.	560 SE/SEL/SEC/SL USA/JAPAN with PREMIUM FUEL 24...28° before TDC at 3500 min $^{-1}$ REGULAR FUEL Australia 18...22° before TDC at 3500 min $^{-1}$
8 *	Adjustment plug	Resistance between EI control-unit plug term.3 and battery negative. Short circuit to ground from adjustment plug including connecting cable. Note: Basic microcard does not include detailed trouble-shooting.	USA/JAPAN 750 Ω Australia 220 Ω infinite Ω
9	Throttle-valve switch, full-load contact and leads	Disconnect throttle-valve switch plug connection. Resistance, throttle-valve switch plug connection term.2 and term.3 (throttle-valve side). Throttle-valve idle position Throttle-valve full-throttle position Disconnect EI control-unit plug. Resistance, throttle-valve switch plug connection term.3 or term.2 (wiring-harness side) to EI control-unit plug term.2 or battery negative.	 infinite Ω approx. 0 Ω approx. 0 Ω (continuity)
10	Voltage supply, EI control unit and ignition coil	Engine idle Voltage at diagnostic socket term.5 (+) and battery terminal (-)	12...14 V max. 1 V below U_B
11	Peak coil current cutoff	Ignition ON Voltage at diagnostic socket term.5 (+) and term.4 (-)	after approx. 1 s 0 V
12	EI control unit	Engine idle Primary voltage, ignition coil term.15 and term.1	280...360 V

* Carry out only if test results for test step 7 or 7a are incorrect.

RAPID DIAGNOSIS CHART (CONTINUED)

No primary signal or ignition spark

Test step	Possible cause of defect	Testing instructions	Test specifications
1	Pulse generator	Resistance between EI control-unit plug term.7 and battery negative (insulation test)	infinite Ω
	Pulse generator	Resistance between EI control-unit plug term.7 and term.31d	680...1200 Ω
	Pulse generator	Start engine. Voltage (oscilloscope), EI control-unit plug term.7(+) and term.31d(-)	U_s > 1 V
2	Voltage supply, EI control unit	Ignition ON Voltage, EI control-unit plug term.15(+) and term.31(-)	Battery voltage
3	Voltage supply, primary circuit	Ignition ON Voltage, EI control-unit plug term.16(+) and term.31(-)	Battery voltage
4	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,2... 0,4 Ω 7,3...13,2 k Ω

Ignition coil, primary	0,2...0,4 Ω
Ignition coil, secondary	7,3...13,2 k Ω
High-voltage-distributor-setting	cyl. 1 TDC Ig. dist. marking
Contact resistance, supply leads for EI control unit / primary circuit	max. 0,3 Ω
Coolant-temperature sensor	+ 20° C 2,1...2,9 k Ω + 30° C 1,4...2,0 k Ω + 80° C 280...370 Ω + 90° C 210...280 Ω + 100° C 160...215 Ω

Spark advance without vacuum
Engine at operating temperature, however < approx. 95°C

420 SE, SEL, SEC, SL E 116.968

Fuel	Country	Engine speed min $^{-1}$ or ° crankshaft before TDC
Premium unleaded	USA/JAPAN	3500 28...32°
Regular unleaded	AUSTRALIA	3500 22...26°

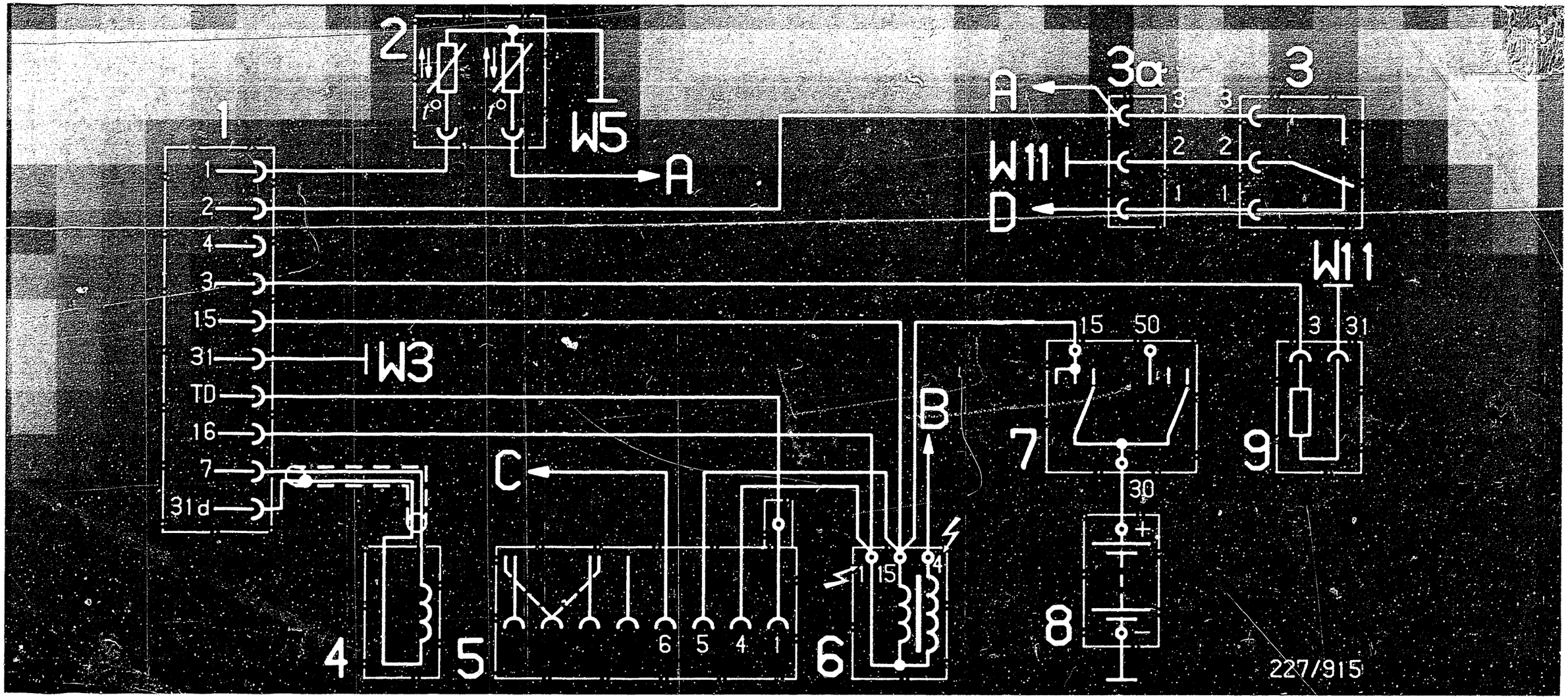
560 SE, SEL, SEC, SL E 117.968

Fuel	Country	Engine speed min $^{-1}$ ° crankshaft before TDC
Premium unleaded	USA, JAPAN	3500 24...28°
Regular unleaded	AUSTRALIA	3500 18...22°

Single adjustment plug	USA/Japan	750 Ω
	Australia	220 Ω
Throttle-valve switch Full-load contact		
Idle position		infinite Ω
Full-throttle position		approx. 0 Ω
Voltage supply EI control unit and ignition coil at engine idle speed		12...14 V max. 1 V below U_B
Peak coil current cutoff after approx. 1s with ignition ON		0 V
Primary voltage at engine idle		280...360 V
Insulation, pulse generator		infinite Ω
Internal resistance, pulse generator		680...1200 Ω
Voltage, pulse generator at starting speed		U_s > 1 V

Voltage supply, EI control unit with ignition ON	U_B
Voltage supply, primary circuit with ignition ON	U_B

See Jetronic SIS microcard or Autodata test specifications for setting values for idle speed, exhaust, etc.



High-voltage arrows: Caution, 400 V...25 kV

1 = EI control unit
2 = Coolant-temperature sensor (double NTC)
3 = Throttle-valve switch
3a = Plug connection, throttle-valve switch
4 = Pulse generator
5 = Diagnostic socket
6 = Ignition coil
7 = Ignition and starting switch
8 = Battery
9 = Single adjustment plug

A = To KE-Jetronic control unit
B = To high-voltage distributor
C = Plug connection, engine term. 30
D = To control unit, idle-speed control

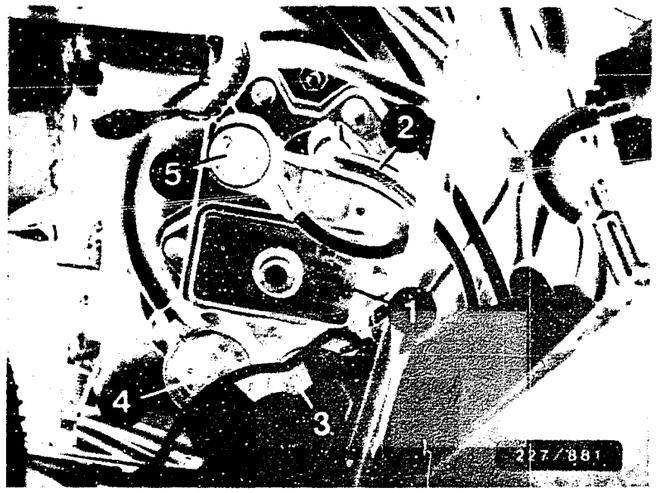
W3 = Ground, front left wheel well (ignition coil)
W5 = Ground, engine
W11 = Ground, engine

ELECTRICAL TERMINAL DIAGRAM

J15 — ⟹ J16 — ⟸

INSTALLATION POSITION OF COMPONENTS

The EI control unit is located on the front left wheel well on vehicle type 126, and on the front left side member (near headlamp) on vehicle type 107.



1 = EI control unit, vehicle type 126
2 = Vacuum hose
3 = 4-contact plug - supply
4 = 4-contact plug - sensor
5 = Coaxial plug - pulse generator

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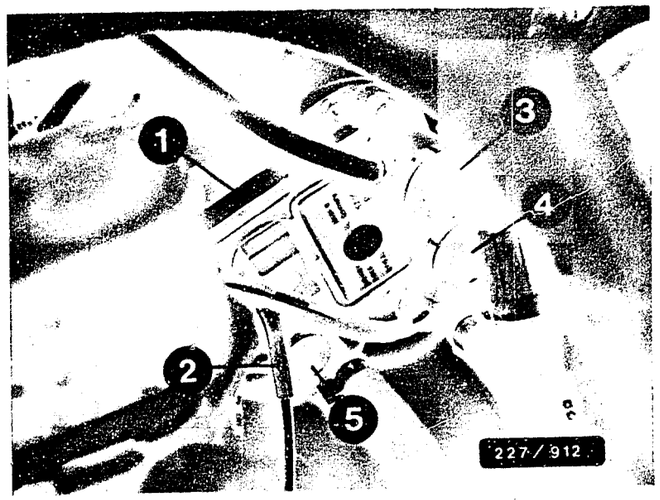
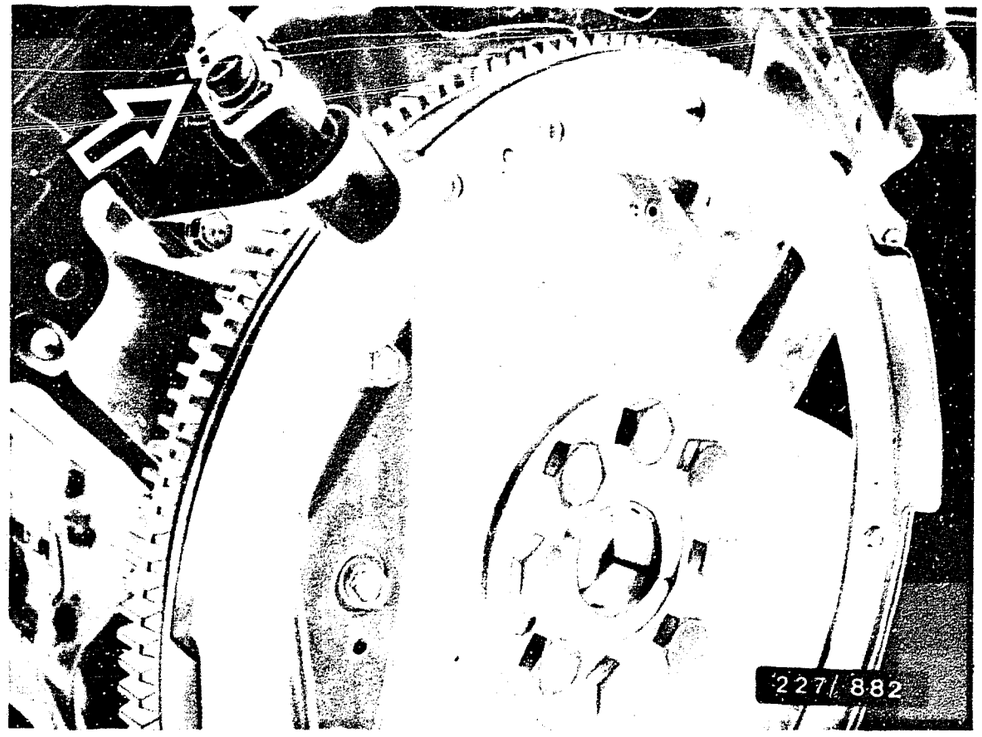
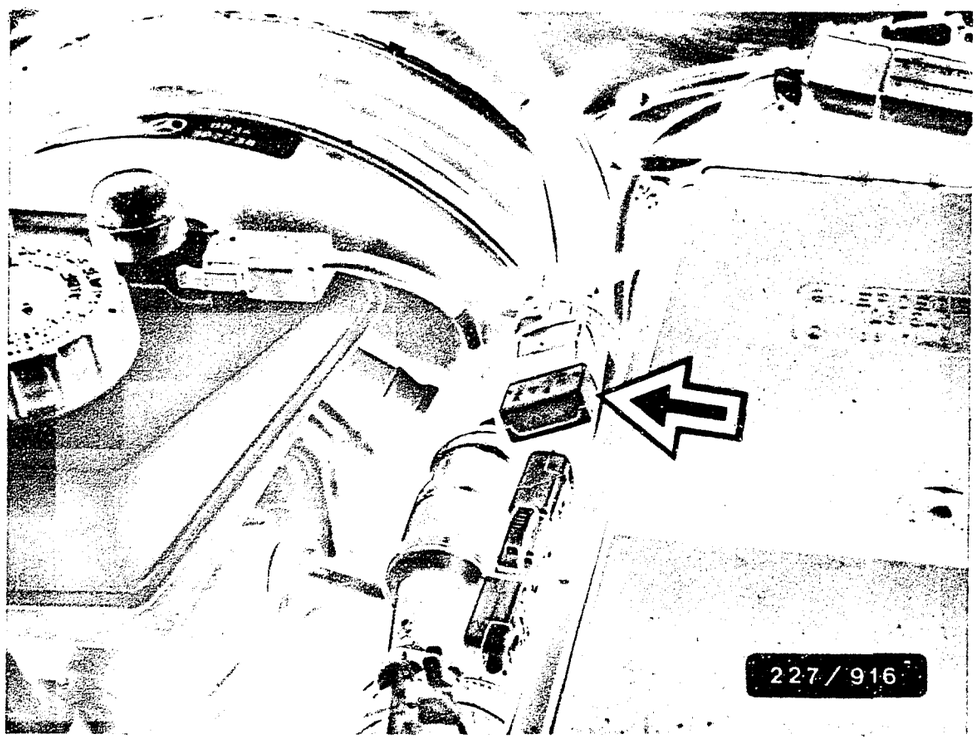
1 = EI control unit, vehicle type 107
2 = Vacuum hose
3 = 4-contact plug - supply
4 = 4-contact plug - sensor
5 = Coaxial plug - pulse generator



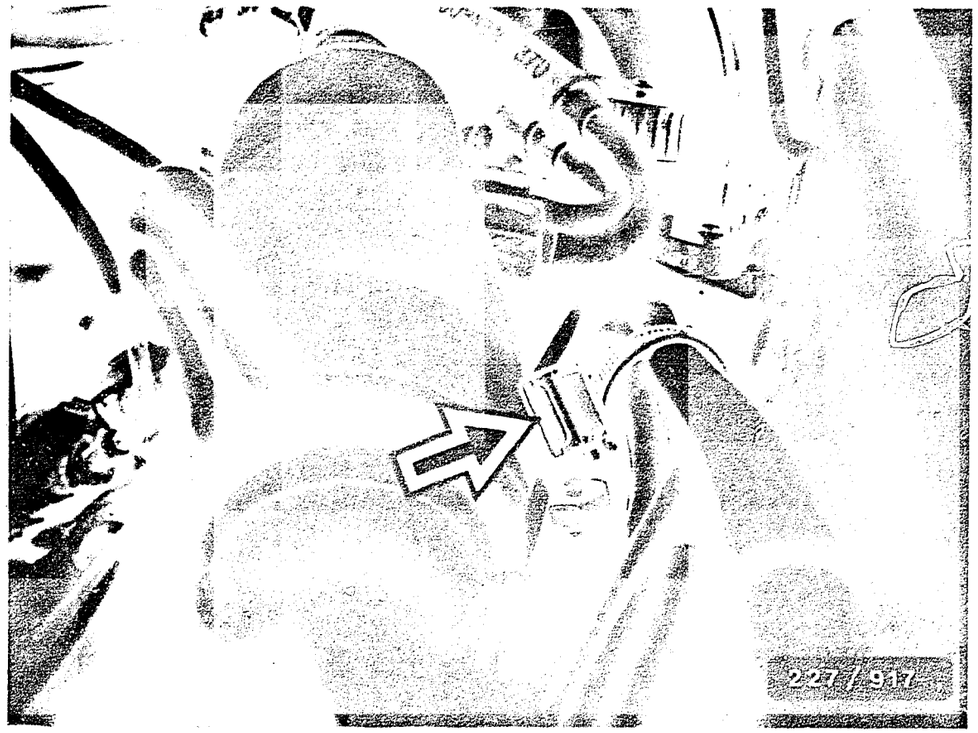


Arrow = Pulse generator

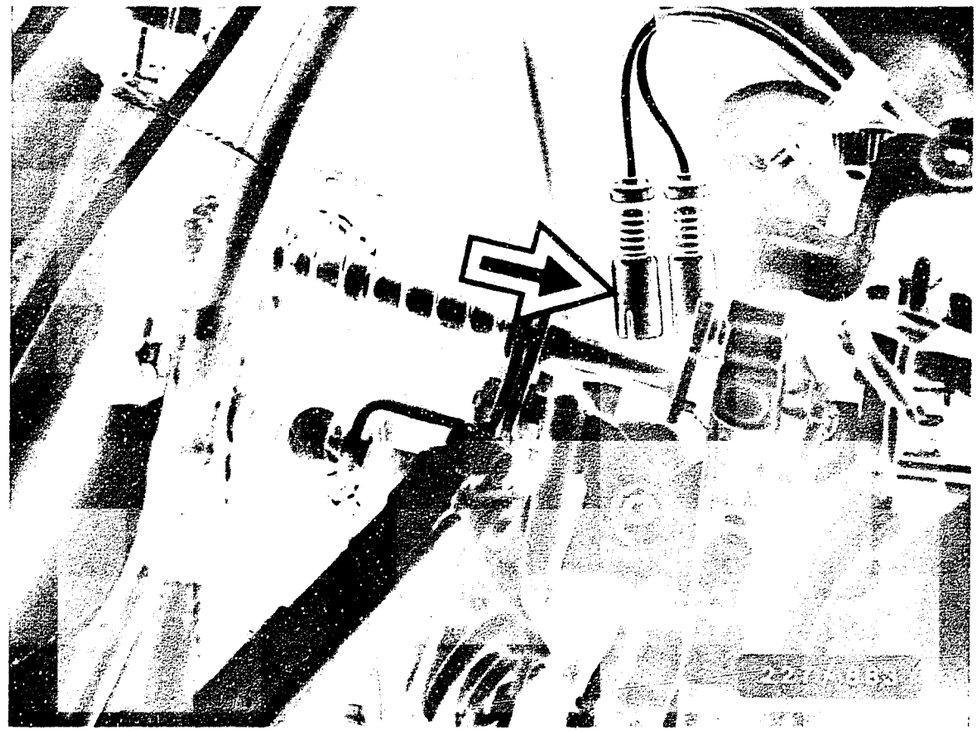
The pulse generator is located on the engine block on left in direction of travel.



Arrow = Single adjustment plug, vehicle type 126

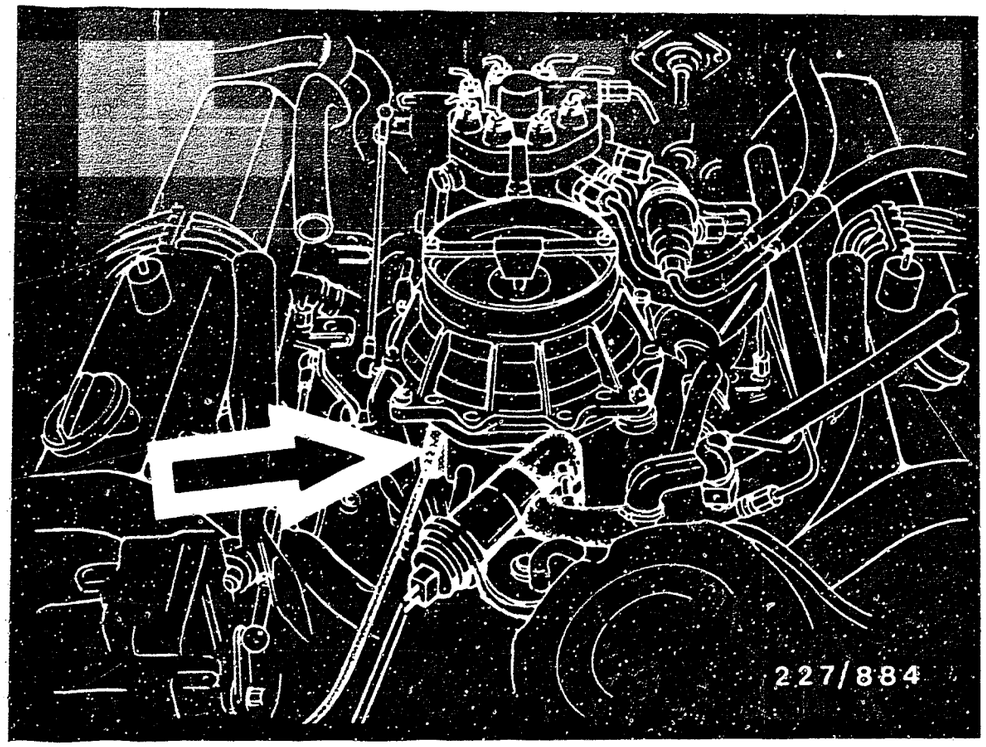


Arrow = Single adjustment plug
(vehicle type 107)



Arrow = Coolant—temperature sensor
(double NTC)

The coolant temperature sensor (green/black lead) is located on the cylinder head, rear left.



Arrow = Throttle-valve switch

The throttle-valve switch is located on the throttle-valve assembly.

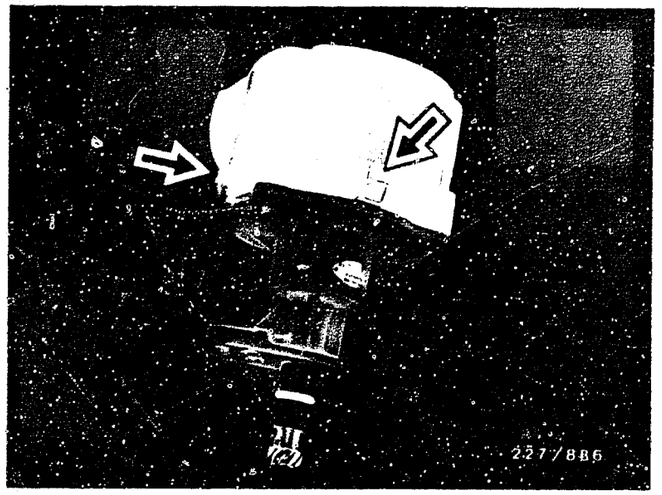
For production reasons: continued on the following coordinate.

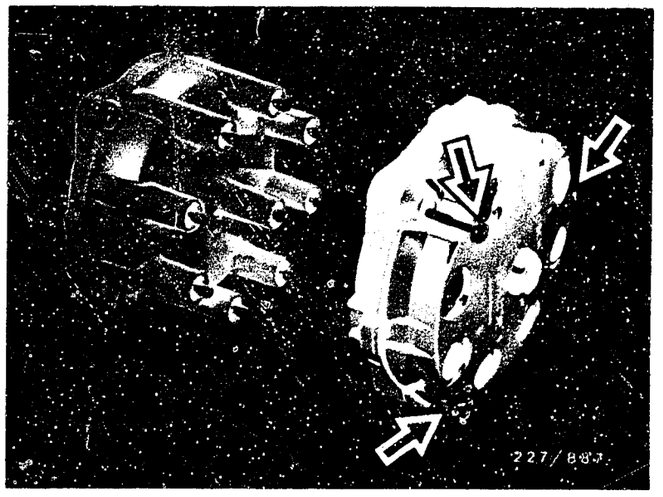
High-voltage distributor, see upper illustration

Instructions for removal:

To remove the hood, unclip the 3 straps (arrows, middle illustration) and pull hood upwards.

The distributor cap is screwed on to the high-voltage distributor with special screws (arrows, lower illustration) together with the protective cap for long-distance interference suppression.





Trouble-shooting instructions : MB-5024

Bosch system : Electronic ignition (EI)

Vehicle make : MERCEDES-BENZ

Basic microcard : PKW-022

Section — Coordinates

SPECIAL FEATURES

Mercedes-Benz

560 SEL/SEC engine 117.968 220kW
Year of manufacture 1985 world-wide
except USA/Japan/Australia

Equipped with:

EI control unit 0 227 400 6..
(with current limiting)

or

EI control unit from Siemens
(Daimler-Benz AG replacement part).

Note:
Bosch and Siemens control units are interchangeable.

Ignition coil 0 221 5..

The ignition system in these vehicles corresponds to the basic microcard with the following auxiliary functions and special features:

* Adjustment plug with lettering EZL (white), position 1-7

Note:
When referring to the basic microcard, note that the test specifications must always be taken from the vehicle-specific SIS brief instructions.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART

The rapid diagnosis chart starting on Coordinate 05 makes it possible for the experienced specialist to rapidly test the ignition system with the required test equipment and aids.

The rapid diagnosis chart contains test-step sequence, causes of defects, testing information, and test specifications.

Using the rapid diagnosis chart

Use the rapid diagnosis chart starting on Coordinate 05 if there is a primary signal or ignition spark.

Use the rapid diagnosis chart starting on Coordinate 09 if there is no primary signal or ignition spark.

Requirements for testing

Battery fully charged, fuel system in good order, engine in good mechanical order (e.g. compression etc.).

Ambient temperature or temperature of the ignition system 0° to 100° C (temperature exerts significant influence on measured values).

The ignition must be switched off before pulling plug connections.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
1	High-voltage side	Visual test, e.g. ignition harness, distributor cap, etc., continuity test, ignition oscillogram.	———
2	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,2...0,4 Ω 7,3...13,2 k Ω
3	High-voltage distributor setting	Engine cyl. 1 TDC. Distributor-rotor center points to housing marking.	———
4 *	Contact resistance	Test voltage-supply leads to EI control unit or primary circuit for contact resistance.	max. 0,3 Ω
5	Transmission-overload protection	Engine idle Resistance of transmission-overload protection switch Automatic transmission driving position "N" or "P" driving position "D" OBSERVE SAFETY REGULATIONS.	 > 20 k Ω < 1 k Ω
6	Pressure sensor	Disconnect EI control-unit vacuum hose. Operate engine at 2000 min^{-1} . Read off spark advance. Connect EI control-unit vacuum hose. Operate engine at 2000 min^{-1} . Read off spark advance.	Ignition timing ADVANCED
7	Coolant-temperature sensor	Disconnect EI control-unit vacuum hose. Operate engine (operating temperature) at 2000 min^{-1} . Read off spark advance. Disconnect both coolant-temperature sensor plugs. Operate engine at 2000 min^{-1} . Read off spark advance. After testing, re-connect coolant-temperature sensor plugs.	Ignition timing RETARDED

* Carry out only when engine not running.

RAPID DIAGNOSIS CHART (CONTINUED)

Primary signal or ignition spark present

Test step	Possible cause of defect	Testing instructions	Test specifications
8	Spark advance	Disconnect EI control-unit vacuum hose. Disconnect throttle-valve switch plug connection. Engine at operating temperature, however < 95°C.	Adjustment-plug position "4" with PREMIUM FUEL unleaded RON 95 16...20° before TDC at 3500 min^{-1} Adjustment-plug position "1" with PREMIUM FUEL leaded RON 98 22...26° before TDC at 3500 min^{-1}
9	Throttle-valve switch, full-load contact and leads	Disconnect throttle-valve switch plug connection. Resistance, throttle-valve switch plug connection term.2 and term.3 (throttle-valve side). Throttle-valve idle position Throttle-valve full-throttle position Disconnect EI control-unit plug. Resistance between throttle-valve plug connection term.3 or term.2 (wiring-harness side) and EI control-unit plug term.2 or battery negative.	 infinite Ω approx.0 Ω approx.0 Ω (continuity)
10	Voltage supply, EI control unit and ignition coil	Engine idle Voltage at diagnostic socket term.5 (+) and battery terminal (−)	12...14 V max. 1 V below U_B
11	Peak coil current cutoff	Ignition ON Voltage at diagnostic socket term.5 (+) and term.4 (−)	after approx. 1 s 0 V
12	EI control unit	Engine idle Primary voltage, ignition coil term.15 and term.1	280...360 V

RAPID DIAGNOSIS CHART (CONTINUED)

No primary signal or ignition spark

Test step	Possible cause of defect	Testing instructions	Test specifications
1	Pulse generator	Resistance between EI control-unit plug term.7 and battery negative (insulation test)	infinite Ω
	Pulse generator	Resistance between EI control-unit plug term.7 and term.31d	680...1200 Ω
	Pulse generator	Start engine. Voltage (oscilloscope), EI control-unit plug term.7(+) and term.31d(-)	U_s > 1 V
2	Voltage supply, EI control unit	Ignition ON Voltage, EI control-unit plug term.15(+) and term.31(-)	Battery voltage
3	Voltage supply, primary circuit	Ignition ON Voltage, EI control-unit plug term.16(+) and term.31(-)	Battery voltage
4	Ignition coil	Resistance, primary term.1 and term.15 Resistance, secondary term.1 and term.4	0,2... 0,4 Ω 7,3...13,2 k Ω

Ignition coil, primary	0,2...0,4 Ω
Ignition coil, secondary	7,3...13,2 k Ω
High-voltage-distributor setting	cyl. 1 TDC Ig. dist. marking
Contact resistance, supply leads for EI control unit / primary circuit	max. 0,3 Ω

Transmission-overload protection switch

Driving position "N" or "P"	> 20 k Ω
Driving position "D"	< 1 Ω

Coolant-temperature sensor

+ 20 C	2,1...2,9 k Ω
+ 30 C	1,4...2,0 k Ω
+ 80 C	280...370 Ω
+ 90 C	210...280 Ω
+ 100 C	160...215 Ω

Spark advance without vacuum, engine at operating temperature, however < ca. 95°C

Fuel	Adjustment plug EZL (white)	Eng. spd. min $^{-1}$ or ° crankshaft before TDC
Premium unleaded RON 95	Position 4	3500 16...20°
Premium leaded RON 98	Position 1	3500 22...26°

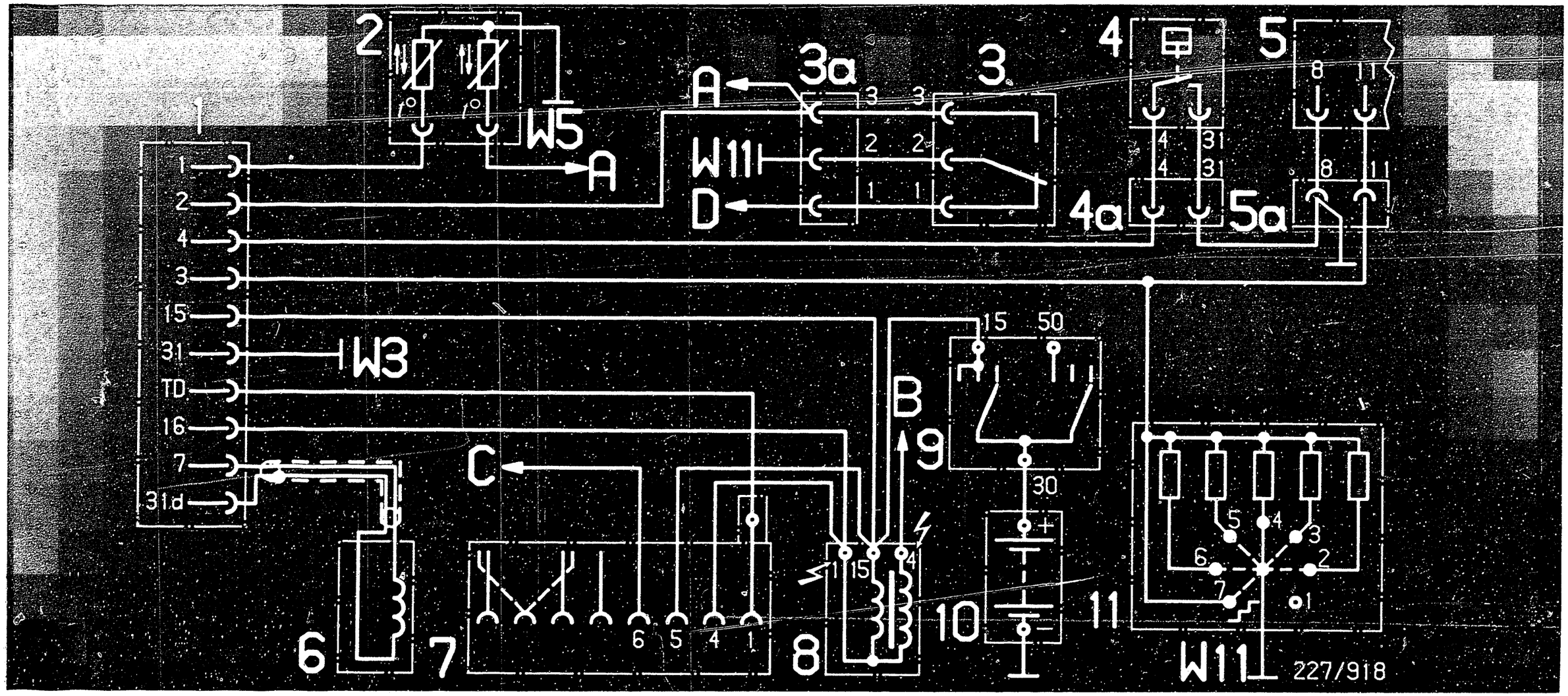
Adjustment-plug position

1 =	infinite Ω
2 =	2,4 k Ω
3 =	1,3 k Ω
4 =	750 Ω
5 =	470 Ω
6 =	220 Ω
7 =	0 Ω

Throttle-valve switch full-load contact	
Idle position	infinite Ω
Full-throttle position	approx. 0 Ω
Voltage supply, EI control unit and ignition coil at engine idle	12...14 V max. 1 V below U_B
Peak coil current cutoff after approx. 1 second with ignition ON	0 V
Primary voltage at engine idle	280...360 V
Insulation of pulse generator	infinite Ω
Internal resistance of pulse generator	680...1200 Ω
Voltage of pulse generator at starting speed	Us > 1 V

Voltage supply, EI control unit with ignition ON	U_B
Voltage supply, primary circuit with ignition ON	U_B

See Jetronic SIS microcard or Autodata test specifications for setting values for idle speed, exhaust, etc.



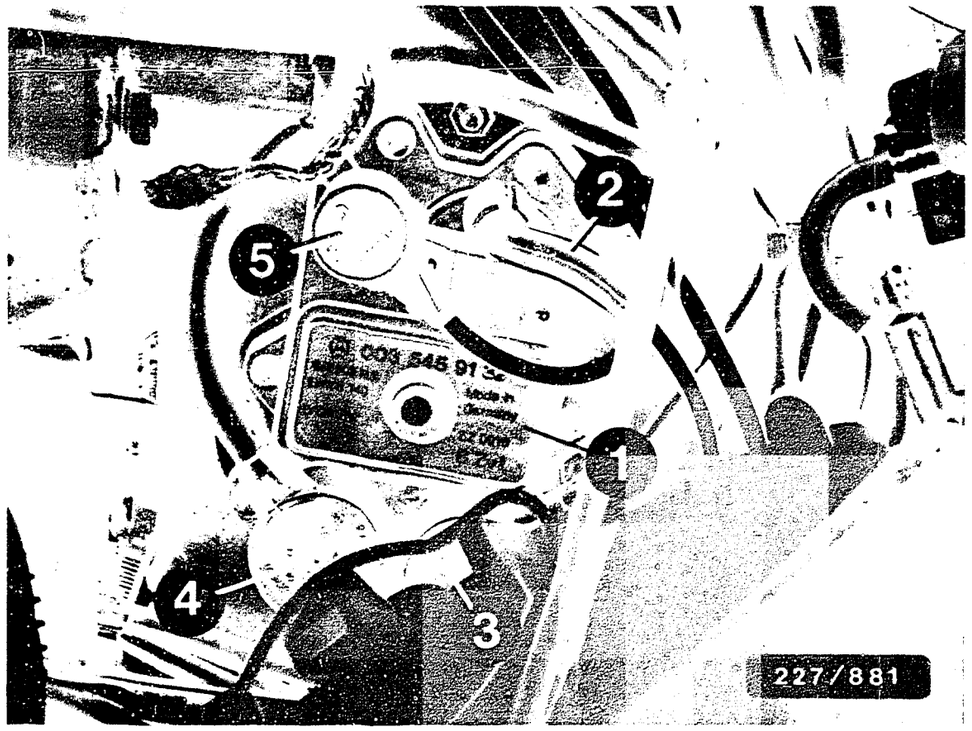
High-voltage arrows: Caution 400 V...25 kV

1 = EI control unit
2 = Coolant-temperature sensor (double NTC)
3 = Throttle-valve switch
3a = Plug connection, throttle-valve switch
4 = Transmission-overload protection switch
4a = Plug connection, transmission-overload protection switch
5 = Instrument cluster
5a = Plug connection, instrument cluster
6 = Pulse generator
7 = Diagnostic socket
8 = Ignition coil
9 = Ignition and starting switch
10 = Battery
11 = Adjustment plug

A = To KE-Jetronic control unit
B = To high-voltage distributor
C = To fuse 2 (term. 30)
D = To control unit for idle-speed control
W3 = Ground, front left wheel well (ignition coil)
W5 = Ground engine
W11= Ground, engine (electrical lead screwed on)

ELECTRICAL TERMINAL DIAGRAM

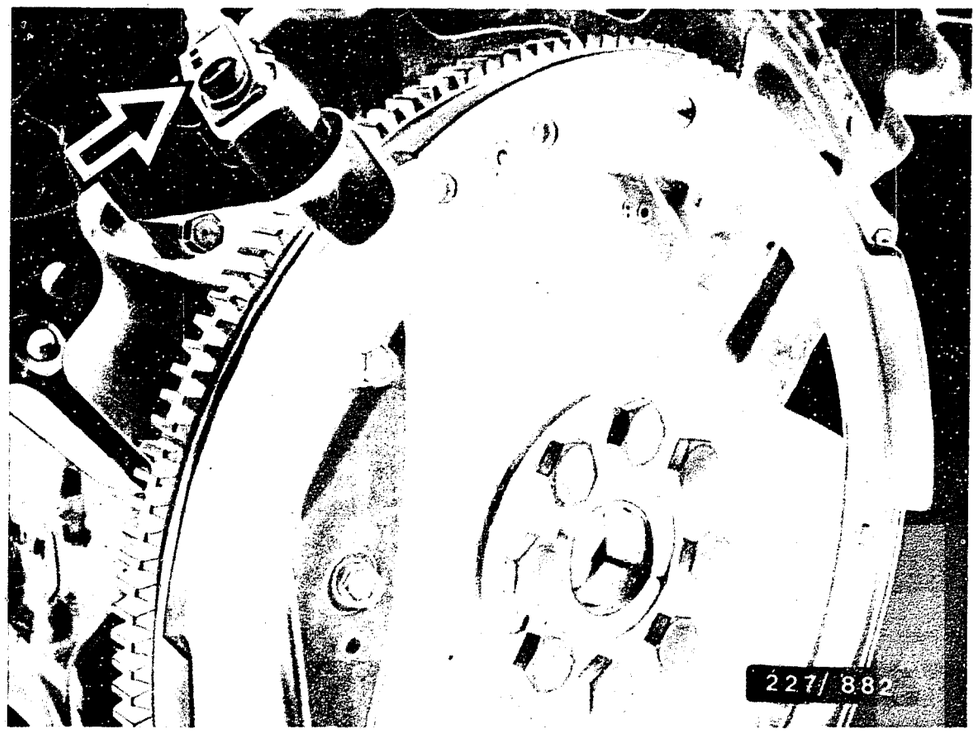
K15 — ⟹ K16 — ⟸



1 = EI control unit
2 = Vacuum hose
3 = 4-contact plug - supply
4 = 4-contact plug - sensor
5 = Coaxial plug - pulse generator

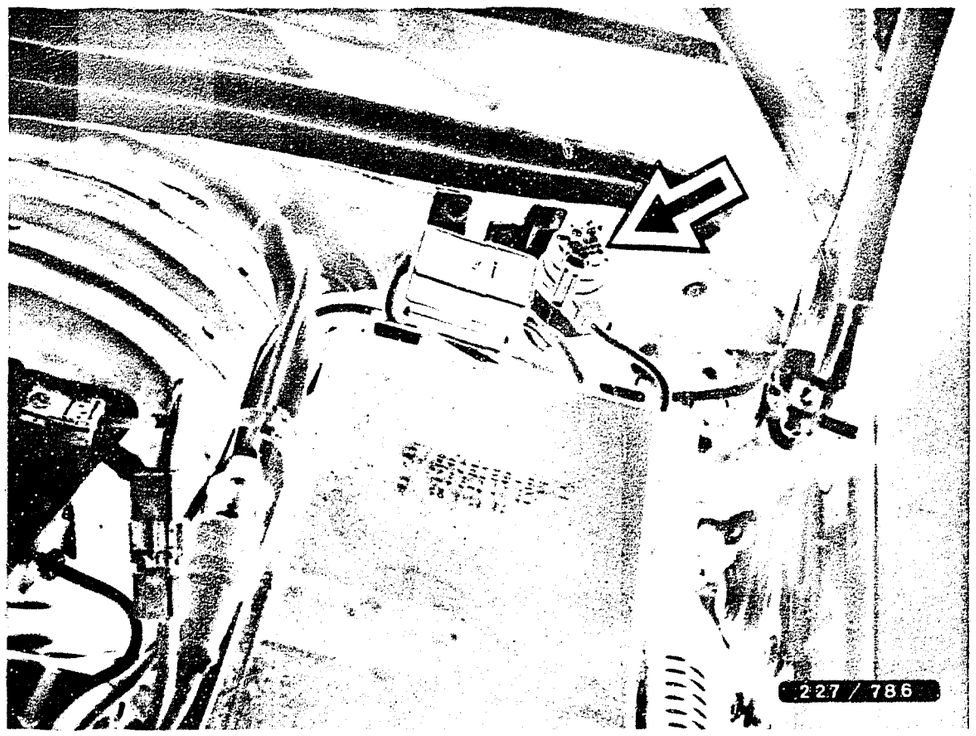
INSTALLATION POSITION OF COMPONENTS

The EI control unit is located on the front left wheel well.

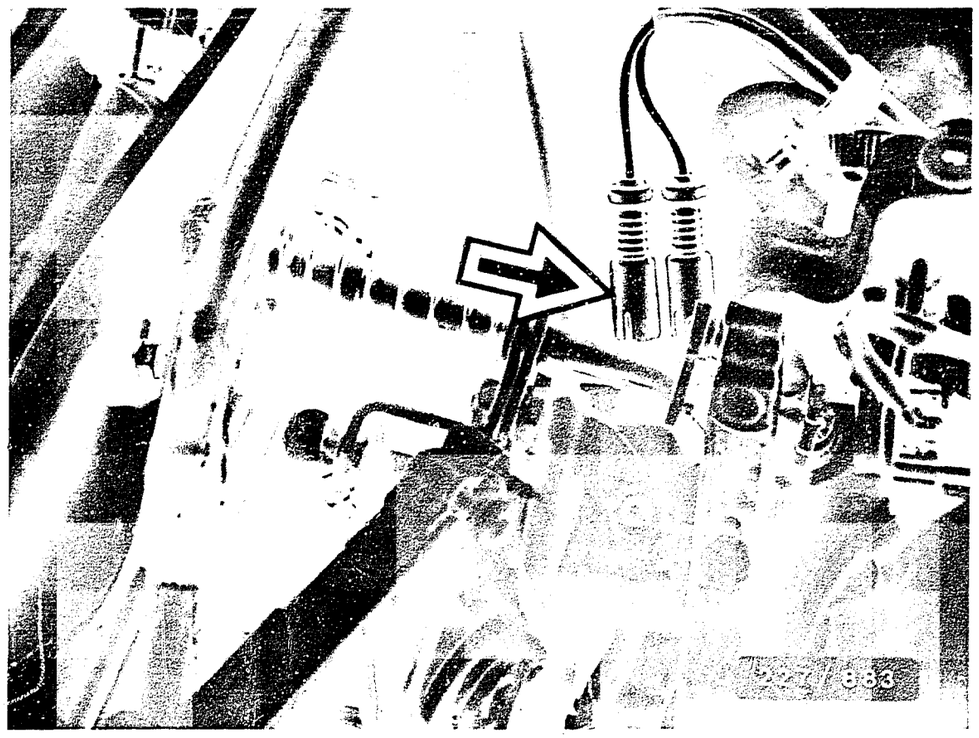


Arrow = Pulse generator

The pulse generator is located on the engine block on left in direction of travel.

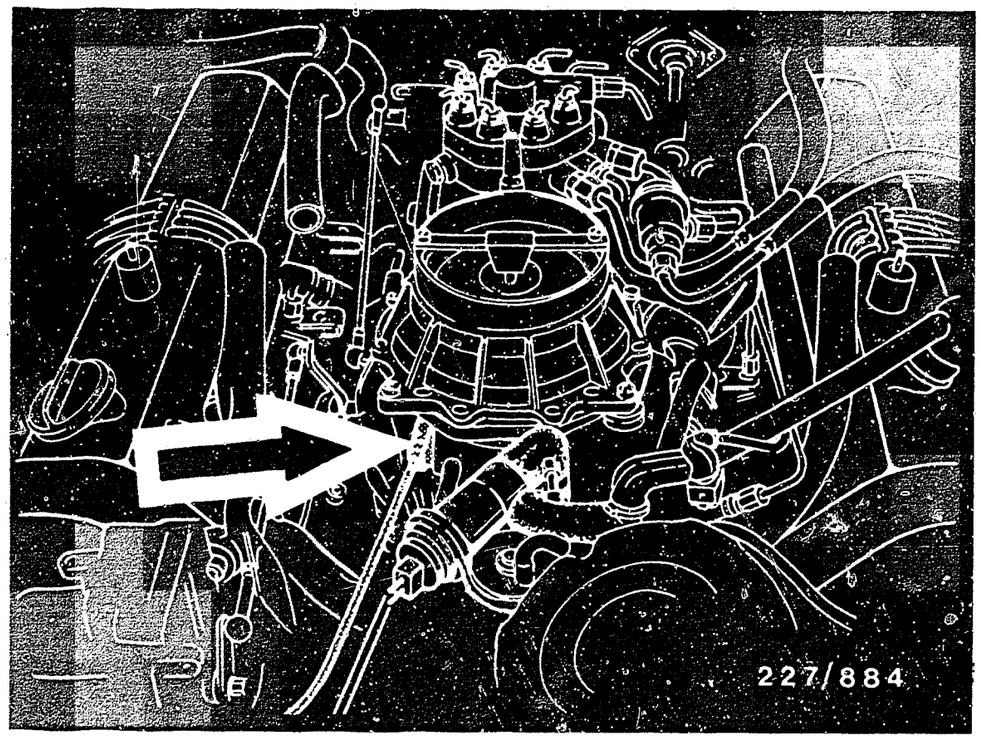


Arrow = Adjustment plug, ignition



Arrow = Coolant—temperature sensor
(double NTC)

The coolant temperature sensor (green/black lead) is located on the cylinder head, rear left.



Arrow = Throttle-valve switch

The throttle-valve switch is located on the throttle-valve assembly.

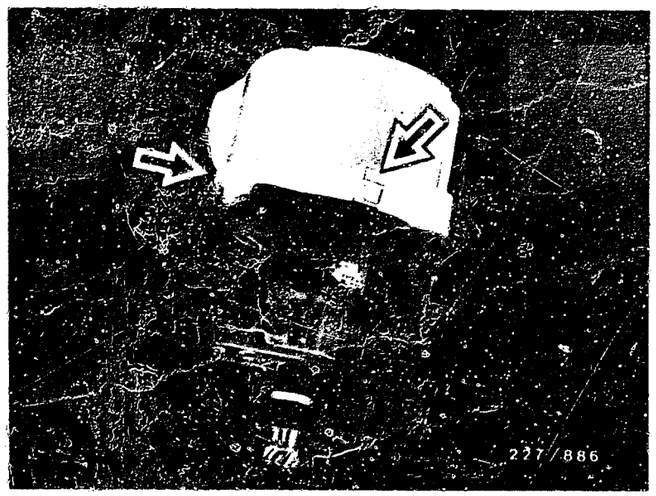
For production reasons:
continued on the following
coordinate.

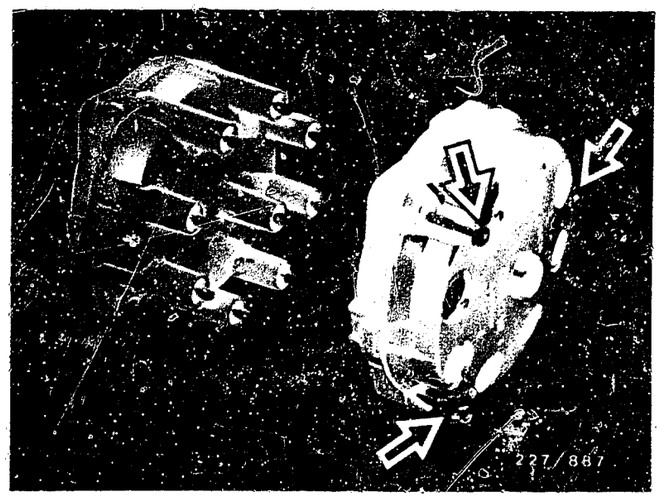
High-voltage distributor, see upper illustration

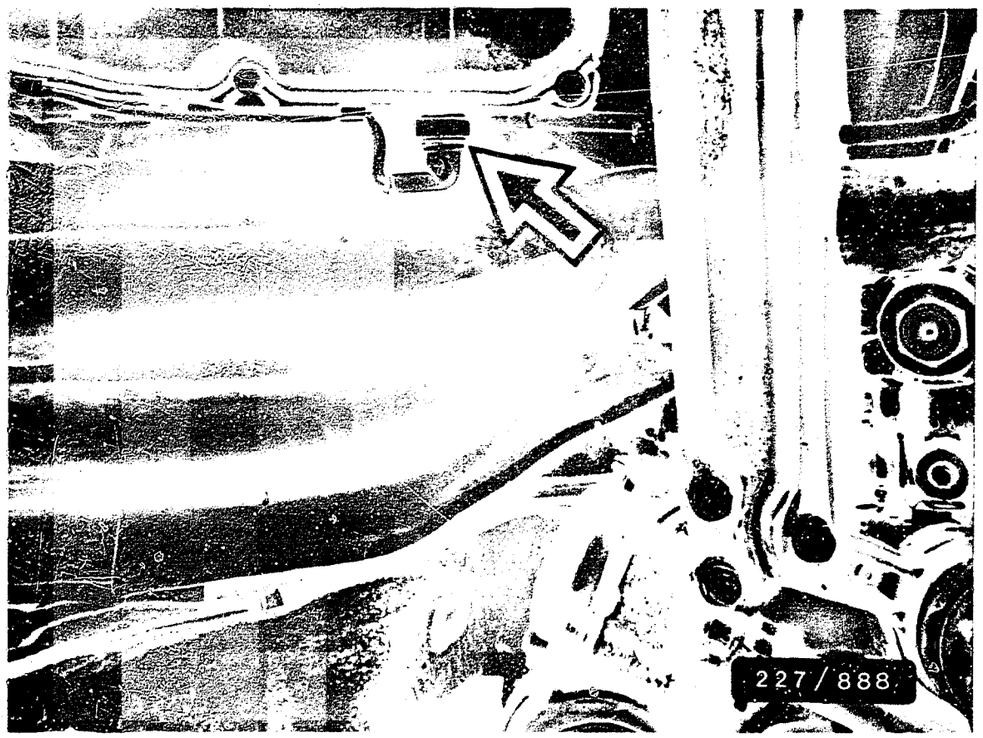
Instructions for removal:

To remove the hood, unclip the 3 straps (arrows, middle illustration) and pull hood upwards.

The distributor cap is screwed on to the high-voltage distributor with special screws (arrows, lower illustration) together with the protective cap for long-distance interference suppression.







Arrow = Transmission-overload protection switch

For production reasons:
continued on the following
coordinate.

Adjust ignition point to the fuel used.

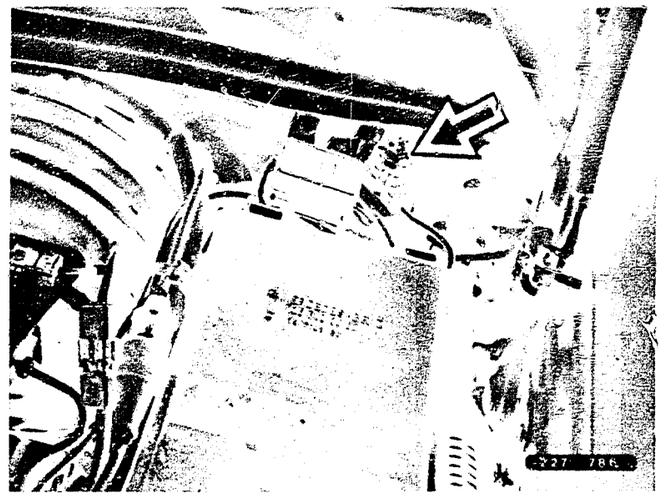
This vehicle can be operated with leaded or unleaded PREMIUM FUEL.
The ignition point must be adjusted for the fuel used.
To adjust, pull adjustment plug out to stop, turn to the correct position, and re-insert (see illustrations).

Position "1" = Premium leaded fuel, RON 98.

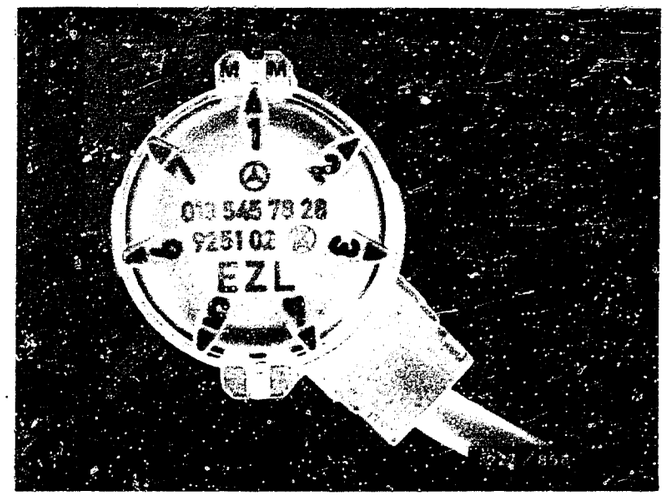
Position "4" = Premium unleaded fuel, RON 95.

The ignition is adjusted towards "RETARD" by 2° crankshaft for each notch.
The maximum ignition-point adjustment at position "6" is equal to 10° crankshaft retardation.

Note:
D o n o t use adjustment-plug position "7", since this signal is used for transmission-overload protection.



Arrow = Adjustment plug



T A B L E O F C O N T E N T S

Trouble-shooting instuctions : BMW-5000

BOSCH system : Motronic

Make of vehicle : BMW

Basic microcard : BMW-509

SPECIAL FEATURES

This microcard contains the test and repair instructions for the Motronic system in:

* BMW 325 i (09.85 ->)
* BMW 325 ix (4-wheel drive) (03.86 ->)
  both with 2.5 l / 6-cyl. engine
  withhout catalytic converter
  Countries of application: West Germany.

New in these vehicles :

- Control unit No.0 261 200 073 :
  ECE version.

- Control unit No.0 261 200 081 :
  Version with "NO $_x$ Control",
  i.e. "limited low-pollution to Level B" (FRG-specific).

- Control unit No.0 261 200 083 :
  Version for tropics.

- Knock-protection function in control unit.

- Low-idle-speed control from BOSCH with temperature-dependent pilot control.

Important note:

If reference is made to a basic microcard, always make sure you use the test specifications from the vehicle-specific brief instructions.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER

The following rapid diagnosis chart makes it possible for the experienced Motronic expert to quickly check the electrical part of the system using the universal test adapter.

The rapid diagnosis chart contains the following information:

* Sequence of test steps.
* Position of V and Ω program-selector switches.
* Notes on how to operate the universal test adapter or other components.
* Test specifications for motortester and multimeter.

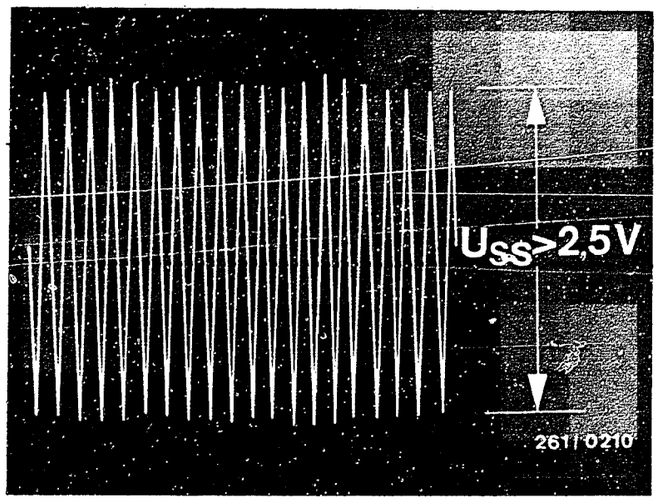
RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONTINUATION)

Valid for control units 0 261 200 073, .. 081, .. 083

Test step	Switch position V	Switch position Ω	Measurement	Measurement at control-unit plug between term.	Remarks	Test specifications (reading)
1	V	1	Insulation resistance of speed sensor.	8 <⟹> 5	Shift gear to neutral. Ignition off. Disconnect Motronic control unit and pump relay. Likewise disconnect transmission control unit (if present) or disconnect multiple plug in area of glove compartment.	greater than 1 M Ω
2	V	2	Insulation resistance of reference-mark sensor.	25 <⟹> 5	—	greater than 1 M Ω
3	V	3	Winding resistance of speed sensor.	8 <⟹> 27	—	0,6...1,6 k Ω
4	V	4	Winding resistance of reference-mark sensor.	25 <⟹> 26	—	0,6...1,6 k Ω
5	V	5	Resistance of temperature sensor, engine (NTC II).	13 <⟹> 5	Resistance temperaure-dependent: (+ 15° C...+ 30° C) : (+ 80° C) :	 1,45...3,3 k Ω 280...360 Ω
6	V	6	Resistance of temperature sensor, air (NTC I).	22 <⟹> 5	Resistance temperature-dependent: (+ 15° C...+ 30° C) :	 1,45...3,3 k Ω
7	V	7	Transmission mesh switch (if electronically controlled trans-mission shift present) or term. 10 open.	10 <⟹> 5	Electronically controlled trans-mission shift : Manually-shifted transmission and automatic :	greater than 1 M Ω greater than 1 M Ω
8	V	8	Not applicable	29 <⟹> 5	—	—
9	V	9	Throttle-valve switch: Resistance of idle contact.	2 <⟹> 5	Accelerator in off-position : Slightly open throttle valve:	smaller 10 Ω greater 1 M Ω

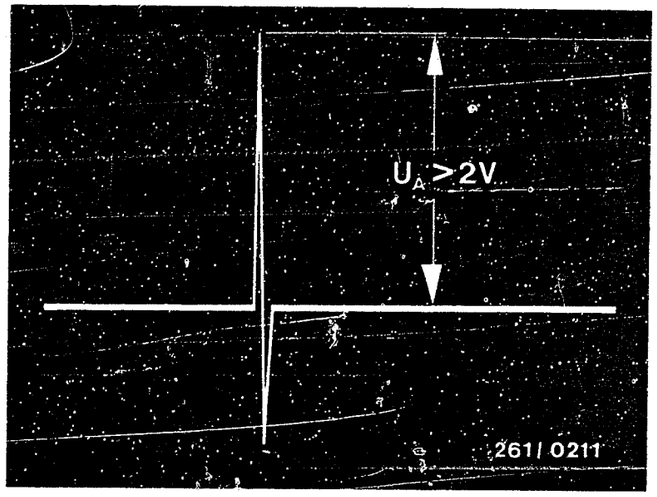
RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONTINUATION)

Test step	Switch position V	Switch position Ω	Measurment and remarks	Measurment at control-unit plug between term.	Test specifications (reading)
10	V	10	Throttle-valve switch: Resistance of full-load contact. Fully depress accelerator:	3 ⟺ 5	smaller than 10 Ω
11	V	11	Resistance of ground cable	16 ⟺ 5	sm. than 10 Ω
12	V	12	Resistance of ground cable	17 ⟺ 5	sm. than 10 Ω
13	V	13	Resistance of ground cable	19 ⟺ 5	sm. than 10 Ω
14	V	14	Not applicable	30 ⟺ 5	———
15	V	15	Resistance of driving-position switch (for automatic and electronically controlled transmission shift). For manually-shifted transmission term. 28 to ground:	28 ⟺ 5	Position switch in position P, N : smaller than 10 Ω In position 1, 2, 3, D, R : greater than 1M Ω sm. than 10 Ω
16	1	15	Speed-sensor oscilloscope. Shift gear to neutral and start.	8 ⟺ 27	See upper illustration
17	2	15	Reference-mark sensor signal with oscilloscope. Shift gear to neutral and start.	25 ⟺ 26	See lower illustration



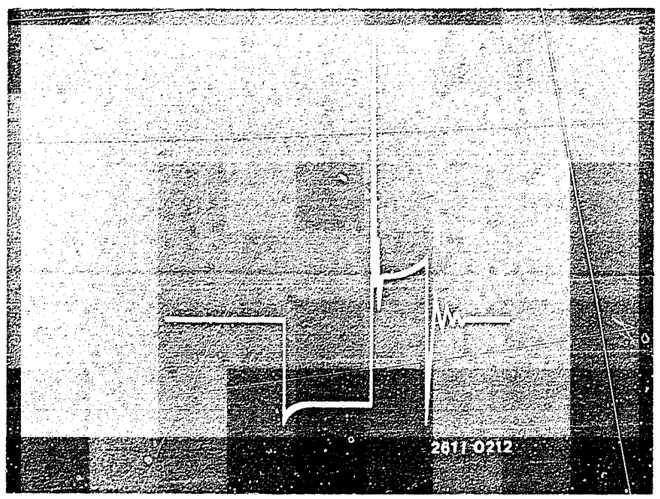
Speed-sensor signal

Reference-mark sensor signal. Positive peak must come first.



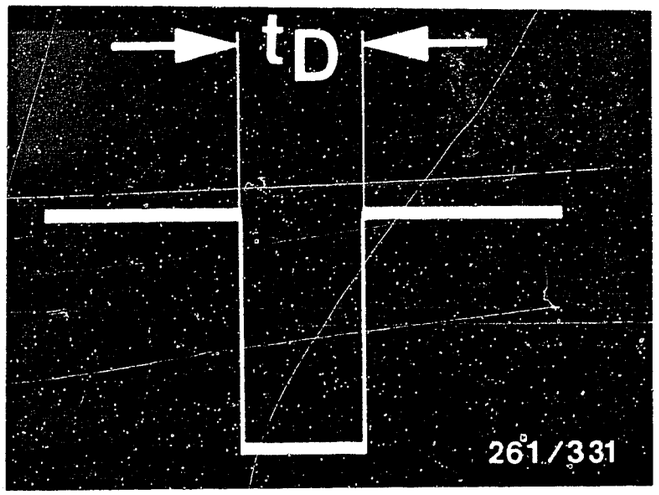
RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONTINUATION)

Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
18	3	15	Not applicable	10 <⟹> 5	
19	4	15	Voltage at air conditioner (if present). Switch on air conditioner.	29 <⟹> 5	greater than 8 V
20	6	15	Voltage of main relay. Ignition on.	35 <⟹> 5	10...15 V
21	7	15	Not applicable	18 <⟹> 5	
22	5	15	Ignition signal of ignition coil with oscilloscope. Ignition off. Connect control unit. Shift gear to neutral and start.	1 <⟹> 5	Signal present (see upper illustration)
23	8	15	Supply voltage for air-flow sensor. Ignition on.	9 <⟹> 5	greater than 4,5 V
24	9	15	Wiper voltage of potentiometer in air-flow sensor. Ignition on.	7 <⟹> 5	Air-flow sensor flap in off-pos. 200...300 mV Air-flow sensor fl. compl. open: greater than 4,2 V
25	10	15	Not applicable	32 <⟹> 5	
26	11	15	Not applicable	28 <⟹> 5	
27	12	15	Start signal from term. 50 Shift gear to neutral and start.	4 <⟹> 5	8...15 V
28	13	15	Dwell-period signal with oscilloscope. Shift gear to neutral and start.	21 <⟹> 5	See lower illustration



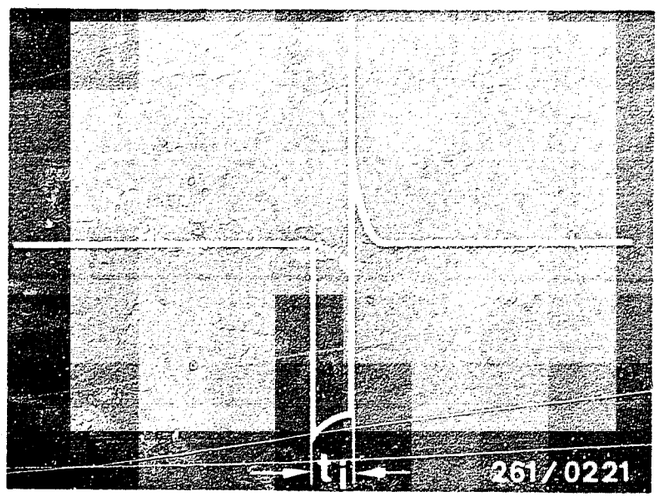
Ignition signal (prim. sig.)

Dwell-period signal.
t_D = Dwell period



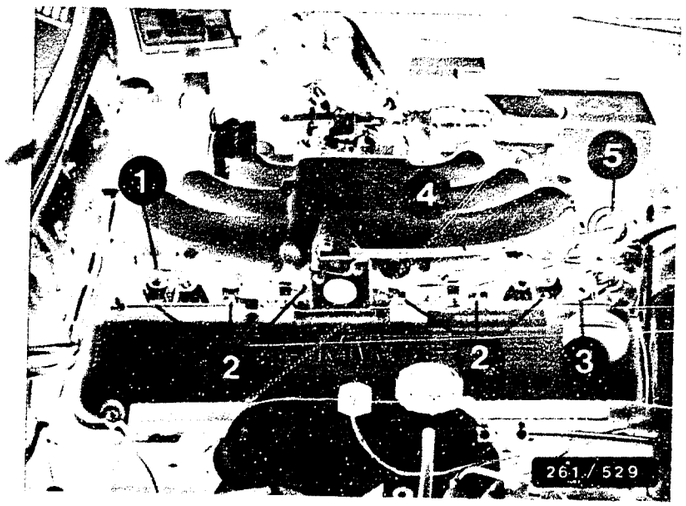
RAPID DIAGNOSIS CHART TO UNIVERSAL TESR ADAPTER (CONTINUATION)

Test step	Switch position V	Switch position Ω	Button	Measurment and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
29	14	15	–	Injection signal from control unit with oscilloscope. Shift gear to neutal and start.	14 <⟹> 5	See upper illustration
30	14	15	T1	As Test step 29, however, after pressing button (NTC II, cold), duration of injection becomes slightly longer. Press button only approx. 2 seconds.	14 <⟹> 5	See upper illustration; t_i becomes slightly wider
31	15	15	–	As Test step 29, however, 2nd output for injection valves	15 <⟹> 5	See upper illustration
32	16	15	–	Injection signal from control unit with oscilloscope (measuring output). Shift gear to neutral and start.	11 <⟹> 5	See upper illustration
33	17	15	–	Voltage at pump relay. Connect pump fuse. Ignition on.	20 <⟹> 5	10...15 V
34	17	15	–	Voltage at pump relay. Pump control in control unit is tested. Shift gear to neutral and start.	20... 5	max. 4 V
35	17	15	T3	Fuel-pressure test: Ignition off. Connect pressure gauge at test connection. Ignition on. Press button T3.	20 to ground	2,8...3,2 bar



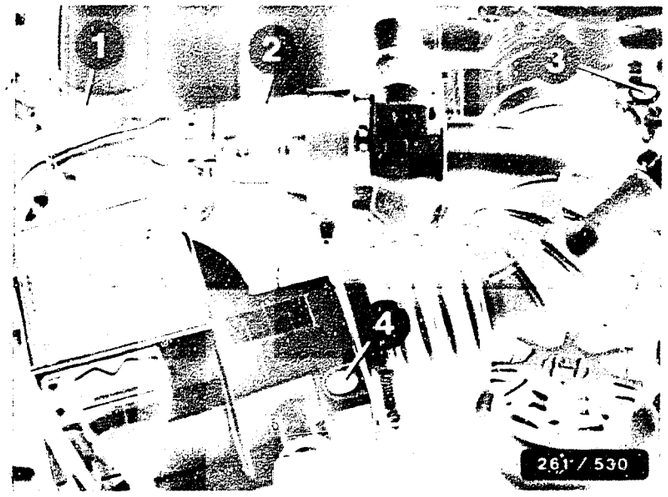
Injection signal
t_i = Duration of injection

1 = Test connection at fuel-distrib. pipe (supply)
2 = Solenoid-op. inj. valves
3 = NTC II
4 = Air hose to intake manif.
5 = Fuel-pressure regulator



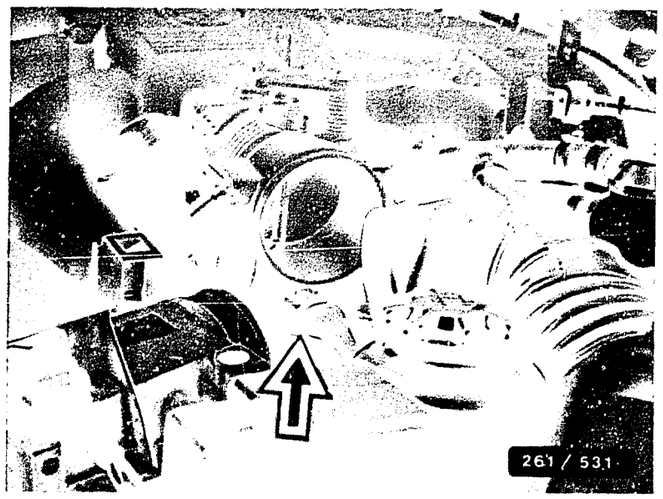
RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONINUATION)

Test step	Switch position V	Switch position Ω	Btn	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
36	17	15	–	Test CO and idle speed: Connect motortester, CO tester and diagnosis cable (1 684 463 122). First measure CO. Engine at normal operating temperature, all consuming devices switched off.	—	0,5...1,5 % by vol. CO 735...785 min $^{-1}$
			T5 and T6	For testing the idle-speed <u>basic</u> setting, simultaneously press buttons T5 and T6 of the universal test adapter or use KDZS 0003 for simultaneous short-circuiting of the LL contact and VL contact. Read off test specification and if necessary, adjust idle speed at the LL adjustment screw.		710...760 min $^{-1}$
37	17	15	–	Spark advance at idle speed. Run engine at normal operating temperature with idle speed (735 ... 785 min $^{-1}$). Speed must be correct, otherwise incorrect spark advance is indicated. Note: no ignition marking, use diagnosis cable 1 684 463 122.	—	5°...15° ° crank
38	17	15	T6	Test spark advance at full load: engine at normal operating temperature. Set speed to 2500 min $^{-1}$. Press button T6.	3 to ground	25°...35° ° crank at 2500 min $^{-1}$

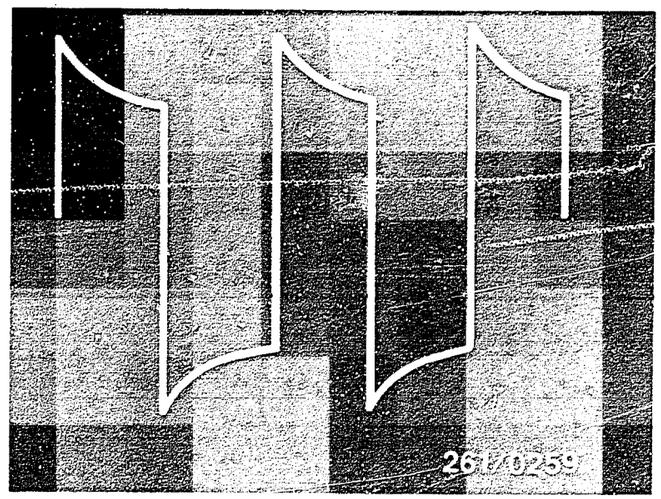


1 = BMW diagnosis connection (for diagnosis cable 1 684 463 122)
2 = Idle actuator
3 = LL adjustment screw
4 = CO adjustment screw

Arrow = Throttle-valve switch

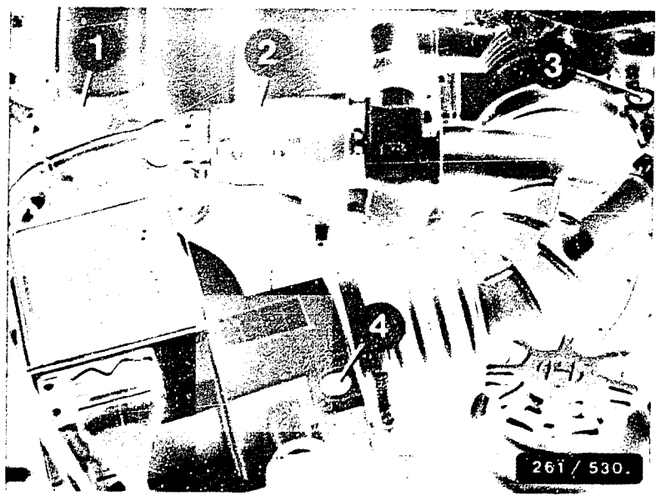


Test step	Switch position V	Switch position Ω	Btn	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
39	17	15	–	Dwell angle at idle speed	———	6°...18°
				Dwell angle at 3000 min $^{-1}$	———	25°...45°
40	17	15	T5	Test overrun cutoff: keep speed of 2000 min $^{-1}$ constant. Press button T5. Injection signals interrupted and speed fluctuates rythmically.	2 to ground	Engine "hunts"
41	18	15	T5 and T6	On-off ratio at idle actuator with dwell-angle tester (% scale). Clip 15 of motortester to red trough. Engine at normal operating temperature runs at idle. With buttons T5 and T6 pressed, speed should be 710...760 min $^{-1}$ (if nec., adjust, see lower illustration).	33 <⟹> 5	62...72 % Signal shape, see upper illustration (Oscilloscope, special input)
42	19	15	T5 and T6	As Test step 41, however, measurement at second winding of idle actuator.	35 <⟹> 5	28...38 % Signal shape, as above



Signals at idle actuator

2 = Idle actuator
3 = LL adjustment screw



Pressure regulator
Fuel pressure 2,8...3,2 bar

Electric fuel pump

Fuel delivery
(measured in return) at least 800 cm ^{3} /30s
Connection voltage
(under load): at least 12 V

Temperature sensor, air (NTC I)

Internal electrical resistance
measured at air-flow sensor
between term. 1 and term. 4
at ambient temperature
(+15°C...+30°C): 1,45...3,3 k Ω

Temperature sensor, engine (NTC II)

Color of plug, blue.
Internal electrical resistance

at ambient temperature
(+ 15° C...+ 30° C): 1,45...3,3 k Ω
engine at normal operating temperature
(approx. + 80° C): 280...360 Ω

Solenoid-operated injection valve
Internal electrical resistance
at ambient tempeature
(+ 15° C...+ 30° C): 15...17,5 Ω

Air-flow sensor
Internal electrical resistance between:
Term.2 and term.4 : 8...2500 Ω (*)
Term.3 and term.4 : 500...1100 Ω
(*) Deflect air-flow sensor flap as far as will go.

Speed sensor and reference-mark sensor

Internal electrical resistance
at ambient temperature
(+15°C...+30°C): 0,6...1,6 k Ω

Throttle-valve switch

Resistance value of idle
contact (term. 2 / ground): 0 Ω
Resistance value of full-load
contact (term. 3 / ground): 0 Ω

For vehicle with controlled transmission shift.
(6-pin connection):
Resistance value of idle
contact (term. 4 / term. 6): 0 Ω
Resistance value of full-load
contact (term. 4 / term. 5): 0 Ω

Idle actuator

Internal electrical resistance
at +15°...+30°C
Term.3 and term.2 : 17...22,5 Ω
Term.1 and term.2 : 19...25 Ω

Low-idle-speed control.

Engine at normal operating temperature,
ambient temperature +15°...+30°C.
Switch off consuming devices.
Idle speed: 735...785 min $^{-1}$

CO concentration: 0,5...1,5 % by vol. CO

See equipment and Autodata microcard for settings for valve clearance and other engine data.

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

Components are listed below, which are not visible in the illustration.

* Speed sensor and reference-mark sensor:
  In the starting-motor ring-gear bell at circumference of flywheel ring gear.

* Fuel filter:
  In engine compartment at left, near to firewall.

* Fuel pump:
  Under the vehicle, near to fuel tank.

* Ground cable of electric fuel pump:
  Under the rear seat bench, at left (trough), ground point at body.

* Control unit:
  In glove compartment behind the cover (see upper illustration).

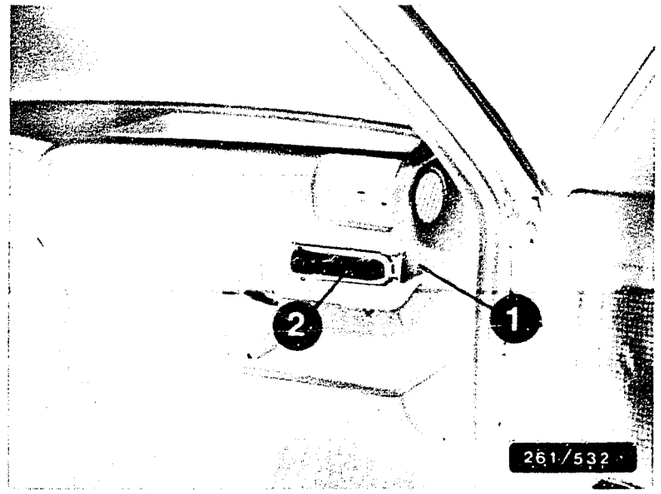
* Temperature sensor, air (NTC I):
  In air-flow sensor.

* Central ground:
  At intake manifold pipe of 5th cylinder.

* Throttle-valve switch:
  At bottom of throttle-valve assembly.

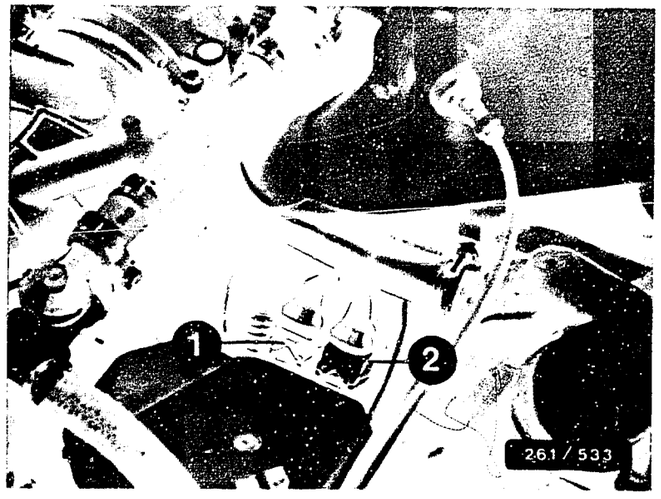
* Battery:
  In trunk at right, under the cover.

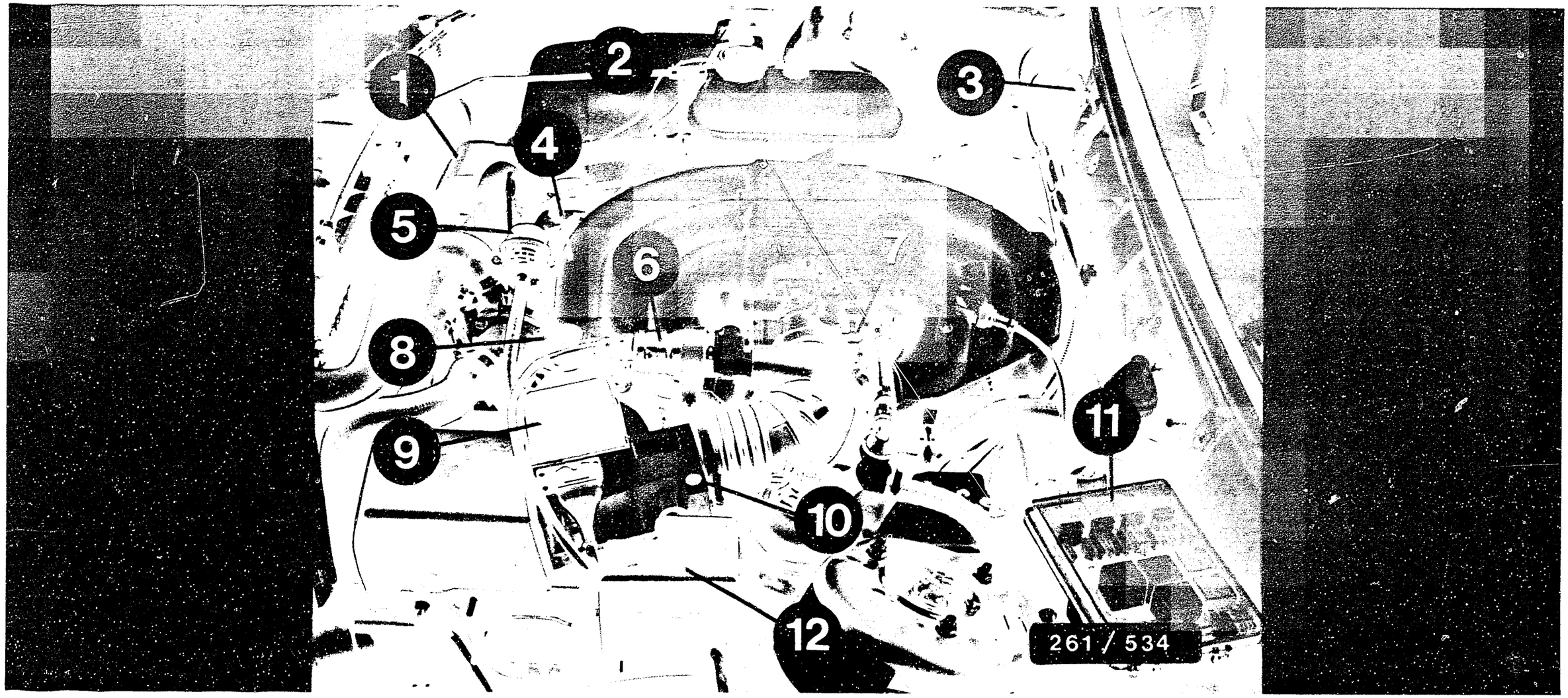
* Connectors for speed sensor and reference-mark sensor:
  At engine block at left (see lower illustration).



1 = Control unit
2 = 35-pin plug

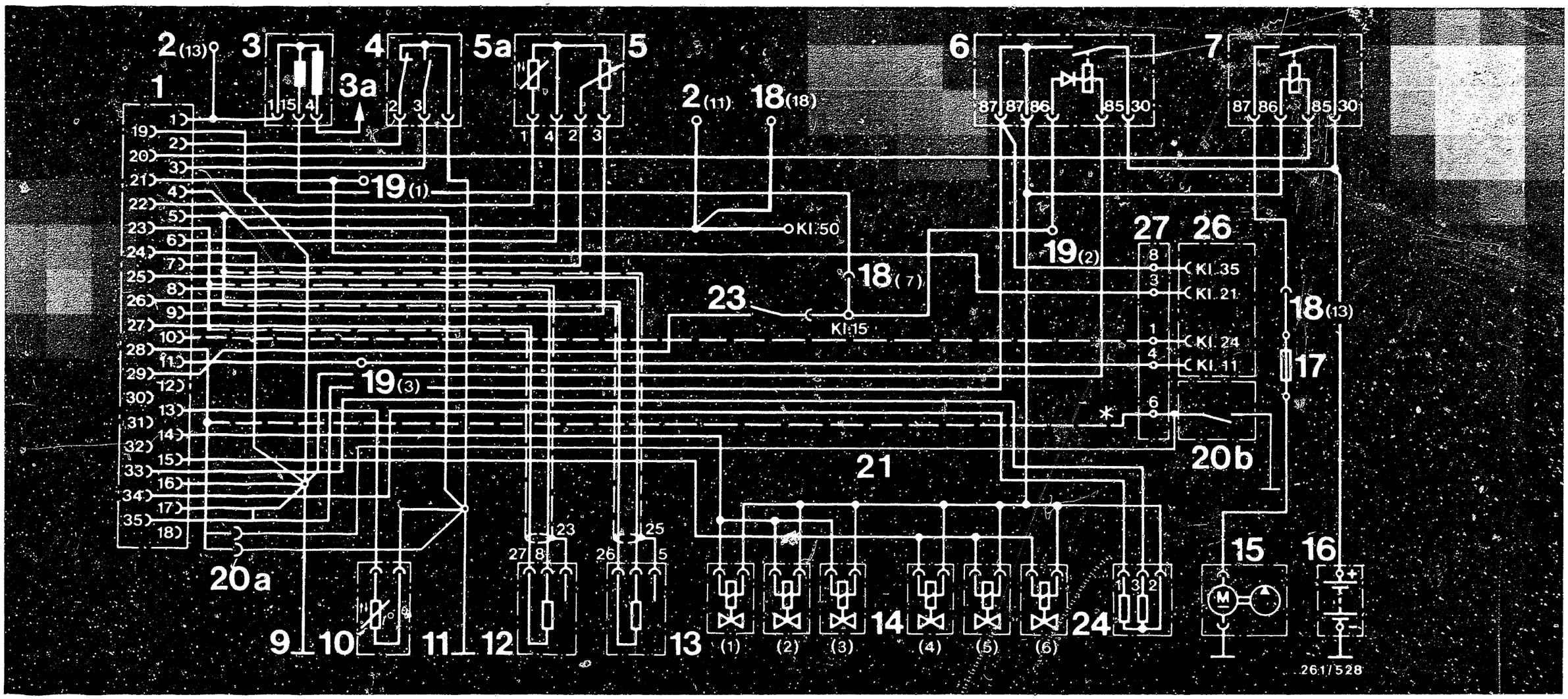
1 = Connector for speed sensor (black plug)
2 = Connector for ref.-mark sensor (gray plug)





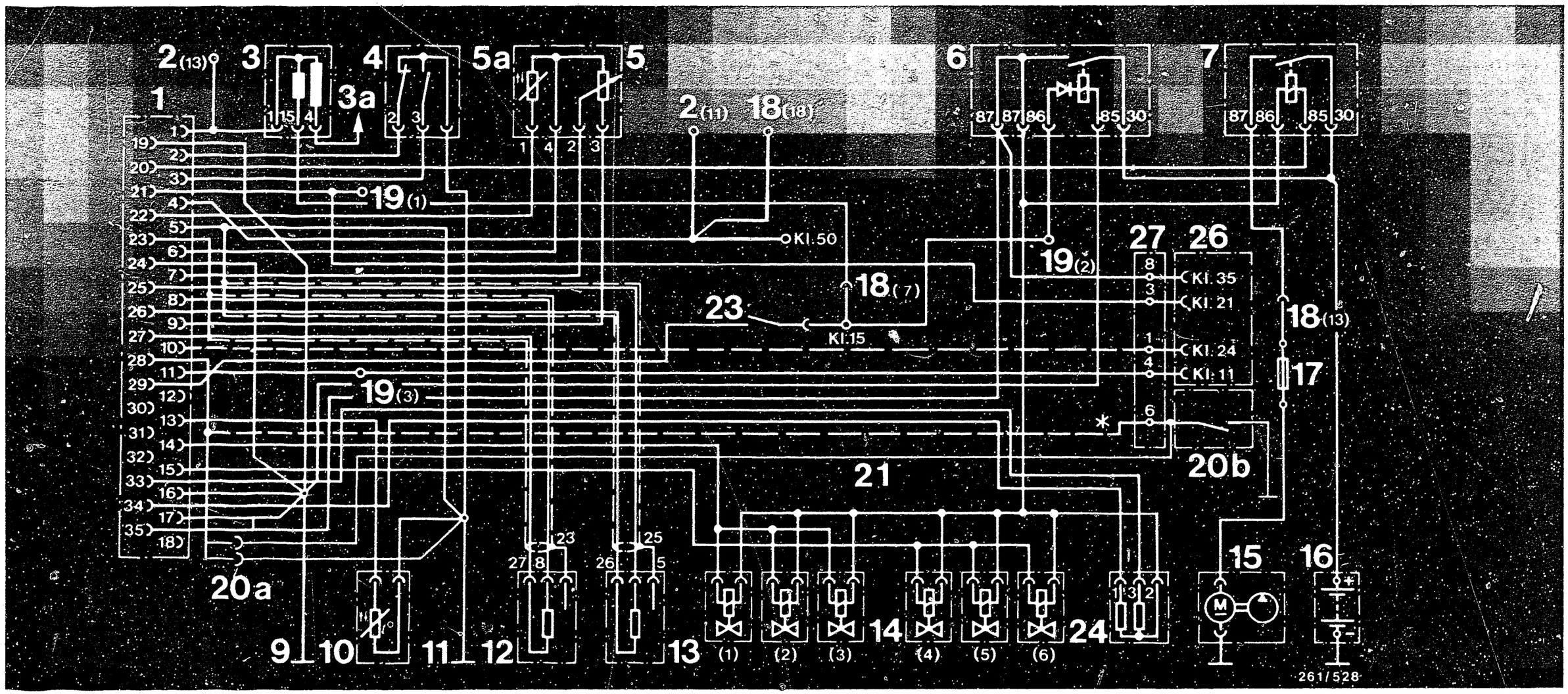
1 = High-voltage distributor
2 = Ignition coil
3 = Positive battery connection
4 = Temperature sensor, engine (NTC II)
5 = Pressure regulator
6 = Idle actuator
7 = Idle adjustment screw
8 = Diagnosis socket outlet
9 = Air-flow sensor
10 = CO adjustment screw
11 = Electrics box
12 = Cover for main relay and pump relay

INSTALLATION POSITION OF COMPONENTS (CONTINUED)



1 = Motronic control-unit plug
2 = Diagnosis plug (No.11, 13)
3 = Ignition coil
3a = to high-voltage distributor
4 = Throttle-valve switch (with potentiometer for vehicles with elec. controlled transm. shift)
5 = Air-flow sensor
5a = Temperature sensor I (air)
6 = Relay 2 (main relay with reversed-polarity protection diode)
7 = Relay 1 (pump relay)
9 = Vehicle ground for control-unit output stage
10 = Temperature sensor (coolant)
11 = Vehicle ground for control unit
12 = Speed sensor
13 = Reference-mark sensor
14 = Injection valves

ELECTRICAL TERMINAL DIAGRAM



15 = Fuel pump
16 = Battery
17 = Pump fuse
18 = Engine plug (No.7, 13, 18)
19 = Plug connection (in glove compartment)
20a = Automatic and elec. controlled transmission shift:
Plug connection disconnected.
Manually-shifted transmission:
Plug connection connected (term. 28 to ground)

20b = Automatic and electronically controlled transmission shift:
In position P and N to ground
In position D, 1, 2, 3, R, open
21 = Lead only for automatic
23 = Switch at air-conditioner compressor
24 = Idle actuator
26 = Control unit of elec. controlled transmission shift (if present)
27 = Multiple plug in glove compartment (only with elec. controlled transm. shift)
* = dashed lines only for vehicle with elec. controlled transmission shift

ELECTRICAL TERMINAL DIAGRAM (CONTINUATION)

Always pay attention to SAFETY AND PRECAUTIONARY MEASURES in order to avoid damage to the engine, control unit or ignition coil, as well as to prevent danger to persons.

1. CAUTION!
   High-output ignition system with dangerous high and low voltages!

   Contact with components or terminals under voltage may be dangerous (both at the primary and secondary ends).

2. When testing the compression, disconnect the Motronic relay. In this way, undesired injection by the injection valves is avoided.

3. Never start engine when battery not firmly connected.

4. Incorrect polarity of the supply voltage, e.g. through incorrect connection of the battery or ignition coil, may lead to the destruction of the control unit.

5. Never use a fast charger for starting the engine. Provide starting aid only using a second 12 V battery and jump leads.
   Caution! Due to non-uniform demands of the vehicle manufacturer made on electronic products, we recommend that a 24 V battery never be used for providing starting aid. Observe the vehicle owner's manual.

6. Disconnect the battery from the vehicle electrical system before boost charging.

7. When charging the battery in the vehicle or providing starting aid, observe the instructions in the operating manual of the fast charger, as well as the instructions from the vehicle manufacturer.

8. Never disconnect the battery from the vehicle electrical system when the engine is running.

9. Never short circuit ignition coil term. 1 to ground (e.g. for switching off the engine). Ignition coil and, under certain circumstances, control unit are destroyed.

10. Never connect the positive battery terminal to ignition coil term. 1. Control unit is destroyed.

11. Never diconnect or connect wiring-harness plug of control unit when ignition is switched on.

12. When temperatures are above +80°C (drying oven), the control unit must be removed.

13. When welding (electric spot welding), the control unit must be removed.

14. When installing an alarm system, observe the installation instructions for Motronic vehicles or the SIS microcard ALL-500.
    Make sure that the alarm relay is not destroyed by external fields (e.g. from ignition cables) so that it responds in a defective manner.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : BMW-5001

BOSCH system : Motronic

Vehicle make : BMW

Basic microcard : BMW-509

SPECIAL FEATURES

This microcard contains the testing and repair instructions for the Motronic in:

* BMW 525 e (09.85->)
  without catalytic convertor
  2.7 l / 6-cylinder engine

  Countries of application : Germany

New with this vehicle:

- Knock-protection function in control unit
- BOSCH closed-loop idle-speed control with temperature-dependent pre-control.

For production reasons:
continued on the following
coordinate.

RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER

The following rapid diagnosis chart makes it possible for the experienced Motronic expert to quickly check the electrical part of the system using the universal test adapter.

The rapid diagnosis chart contains the following information:

* Sequence of test steps.
* Position of V and Ω program-selector switches.
* Notes on how to operate the universal test adapter or other components.
* Test specifications for motortester and multimeter.

RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONTINUATION)

Valid for control units 0 261 200 074, –, –

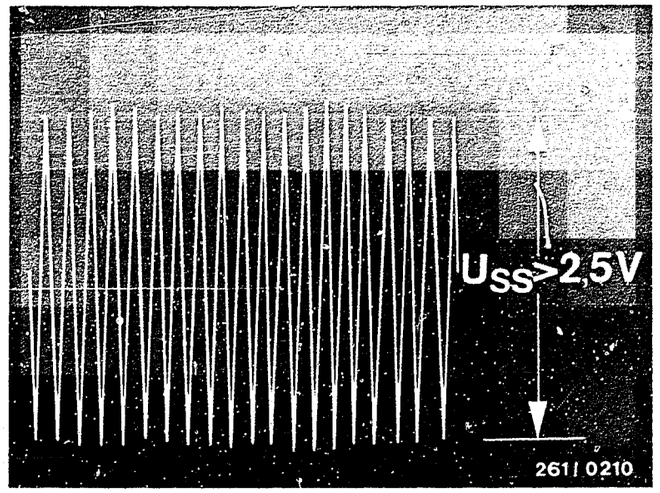
Test step	Switch position V	Switch position Ω	Measurement	Measurement at control-unit plug between term.	Remarks	Test specifications (reading)
1	V	1	Insulation resistance of speed sensor.	8 <⟹> 5	Shift gear to neutral. Ignition off. Disconnect Motronic control unit and pump relay. Likewise disconnect transmission control unit (if present) or disconnect multiple plug in area of glove compartment.	greater than 1 M Ω
2	V	2	Insulation resistance of reference-mark sensor.	25 <⟹> 5	—	greater than 1 M Ω
3	V	3	Winding resistance of speed sensor.	8 <⟹> 27	—	0,6...1,6 k Ω
4	V	4	Winding resistance of reference-mark sensor.	25 <⟹> 26	—	0,6...1,6 k Ω
5	V	5	Resistance of temperature sensor, engine (NTC II).	13 <⟹> 5	Resistance temperaure-dependent: (+ 15° C...+ 30° C) : (+ 80° C) :	 1,45...3,3 k Ω 280...360 Ω
6	V	6	Resistance of temperature sensor, air (NTC I).	22 <⟹> 5	Resistance temperature-dependent: (+ 15° C...+ 30° C) :	 1,45...3,3 k Ω
7	V	7	Transmission mesh switch (if electronically controlled trans-mission shift present) or term. 10 open.	10 <⟹> 5	Electronically controlled trans-mission shift : Manually-shifted transmission and automatic :	greater than 1 M Ω greater than 1 M Ω
8	V	8	Not applicable	29 <⟹> 5	—	—
9	V	9	Throttle-valve switch: Resistance of idle contact.	2 <⟹> 5	Accelerator in off-position : Slightly open throttle valve:	smaller 10 Ω greater 1 M Ω

M05 — <⟹>

M06 — <⟹>

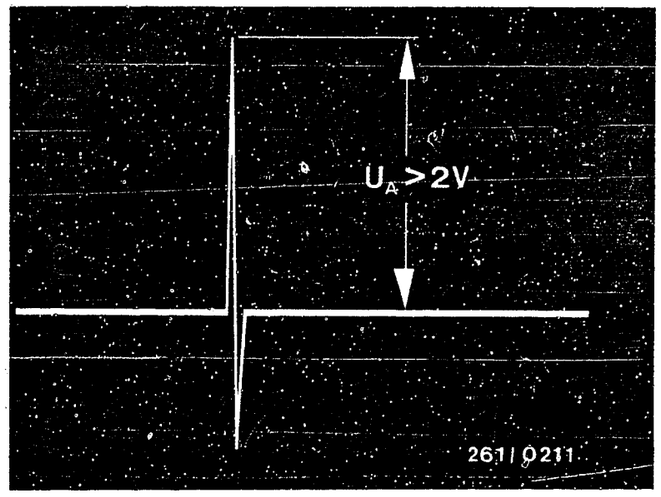
RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONTINUATION)

Test step	Switch position V	Switch position Ω	Measurment and remarks	Measurment at control-unit plug between term.	Test specifications (reading)
10	V	10	Throttle-valve switch: Resistance of full-load contact. Fully depress accelerator:	3 <⟹> 5	smaller than 10 Ω
11	V	11	Resistance of ground cable	16 <⟹> 5	sm. than 10 Ω
12	V	12	Resistance of ground cable	17 <⟹> 5	sm. than 10 Ω
13	V	13	Resistance of ground cable	19 <⟹> 5	sm. than 10 Ω
14	V	14	Not applicable	30 <⟹> 5	———
15	V	15	Resistance of driving-position switch (for automatic and electronically controlled transmission shift). For manually-shifted transmission term. 28 to ground:	28 <⟹> 5	Position switch in position P, N : smaller than 10 Ω In position 1, 2, 3, D, R : greater than 1M Ω sm. than 10 Ω
16	1	15	Speed-sensor oscilloscope. Shift gear to neutral and start.	8 <⟹> 27	See upper illustration
17	2	15	Reference-mark sensor signal with oscilloscope. Shift gear to neutral and start.	25 <⟹> 26	See lower illustration

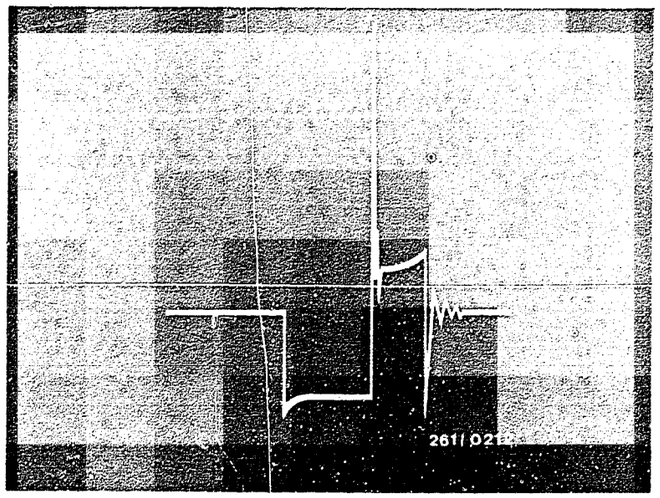


Speed-sensor signal

Reference-mark sensor signal. Positive peak must come first.

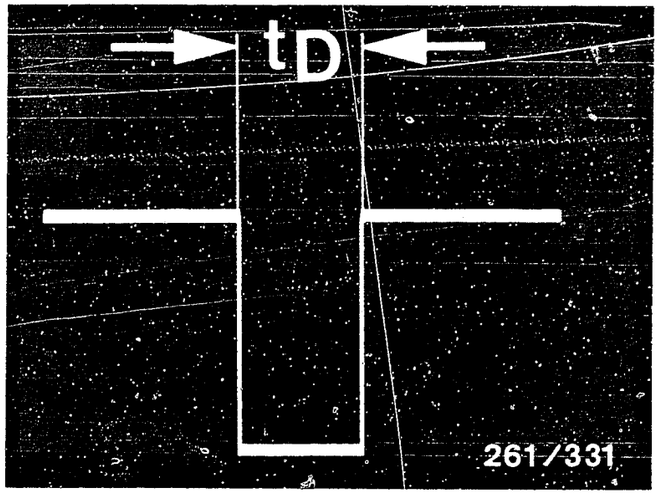


Test step	Switch position V	Switch position Ω	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
18	3	15	Not applicable	10 <⟹> 5	
19	4	15	Voltage at air conditioner (if present). Switch on air conditioner.	29 <⟹> 5	greater than 8 V
20	6	15	Voltage of main relay. Ignition on.	35 <⟹> 5	10...15 V
21	7	15	Not applicable	18 <⟹> 5	
22	5	15	Ignition signal of ignition coil with oscilloscope. Ignition off. Connect control unit. Shift gear to neutral and start.	1 <⟹> 5	Signal present (see upper illustration)
23	8	15	Supply voltage for air-flow sensor. Ignition on.	9 <⟹> 5	greater than 4,5 V
24	9	15	Wiper voltage of potentiometer in air-flow sensor. Ignition on.	7 <⟹> 5	Air-flow sensor flap in off-pos. 200...300 mV Air-flow sensor fl. compl. open: greater than 4,2 V
25	10	15	Not applicable	32 <⟹> 5	
26	11	15	Not applicable	28 <⟹> 5	
27	12	15	Start signal from term. 50 Shift gear to neutral and start.	4 <⟹> 5	8...15 V
28	13	15	Dwell-period signal with oscilloscope. Shift gear to neutral and start.	21 <⟹> 5	See lower illustration



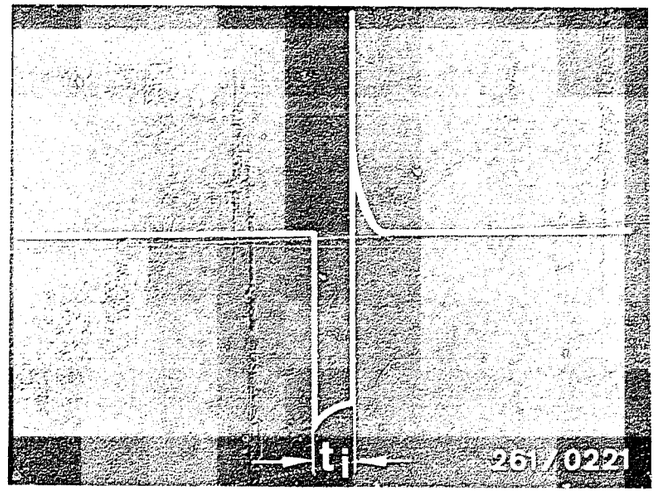
Ignition signal (prim. sig.)

Dwell-period signal.
t_D = Dwell period



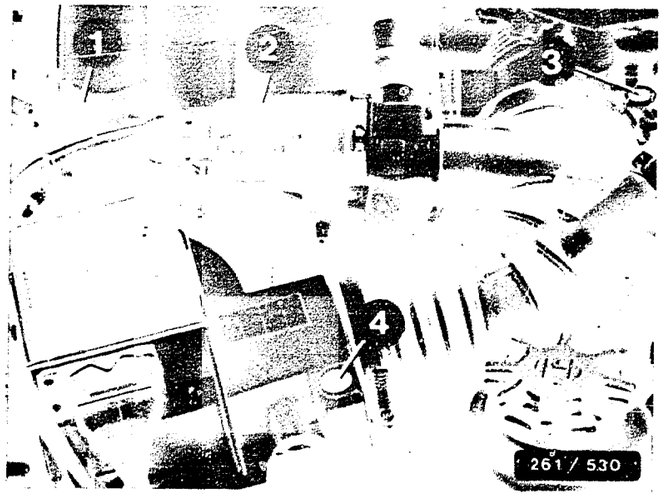
RAPID DIAGNOSIS CHART TO UNIVERSAL TESR ADAPTER (CONTINUATION)

Test step	Switch position V	Switch position Ω	Button	Measurment and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
29	14	15	–	Injection signal from control unit with oscilloscope. Shift gear to neutal and start.	14 <⟹> 5	See upper illustration
30	14	15	T1	As Test step 29, however, after pressing button (NTC II, cold), duration of injection becomes slightly longer. Press button only approx. 2 seconds.	14 <⟹> 5	See upper illustration; t_i becomes slightly wider
31	15	15	–	As Test step 29, however, 2nd output for injection valves;	15 <⟹> 5	See upper illustration
32	16	15	–	Injection signal from control unit with oscilloscope (measuring output). Shift gear to neutral and start.	11 <⟹> 5	See upper illustration
33	17	15	–	Voltage at pump relay. Connect pump fuse. Ignition on.	20 <⟹> 5	10...15 V
34	17	15	–	Voltage at pump relay. Pump control in control unit is tested. Shift gear to neutral and start.	20 <⟹> 5	max. 4 V
35	17	15	T3	Fuel-pressure test: Ignition off. Connect pressure gauge at test connection. Ignition on. Press button T3.	20 to ground	2,3...2,7 bar



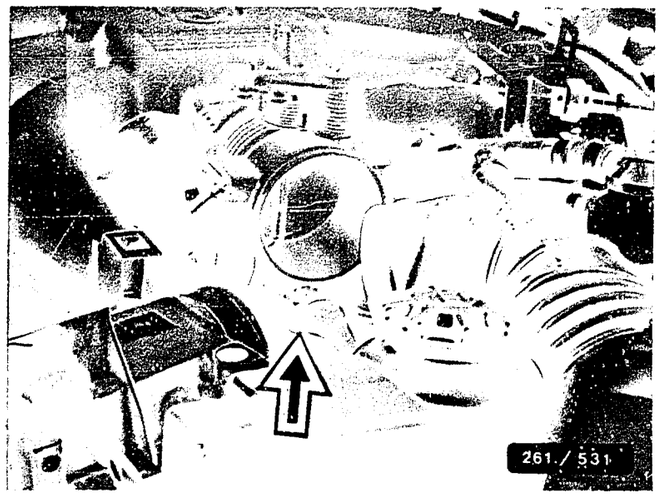
Injection signal
t_i = Duration of injection

Test step	Switch position V	Switch position Ω	Btn	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
36	17	15	–	Test CO and idle speed: Connect motortester, CO tester and diagnosis cable (1 684 463 122). First measure CO. Engine at normal operating temperature, all consuming devices switched off.	—	0,5...1,5 % by vol. CO 695...745 min $^{-1}$
			T5 and T6	For testing the idle-speed <u>basic</u> setting, simultaneously press buttons T5 and T6 of the universal test adapter or use KDZS 0003 for simultaneous short-circuiting of the LL contact and VL contact. Read off test specification and if necessary, adjust idle speed at the LL adjustment screw.		670...720 min $^{-1}$
37	17	15	–	Spark advance at idle speed. Run engine at normal operating temperature with idle speed (735 ... 785 min $^{-1}$). Speed must be correct, otherwise incorrect spark advance is indicated. Note: no ignition marking, use diagnosis cable 1 684 463 122.	—	5...15° ° crank
38	17	15	T6	Test spark advance at full load: engine at normal operating temperature. Set speed to 2500 min $^{-1}$. Press button T6.	3 to ground	9...19° ° crank at 2500 min $^{-1}$



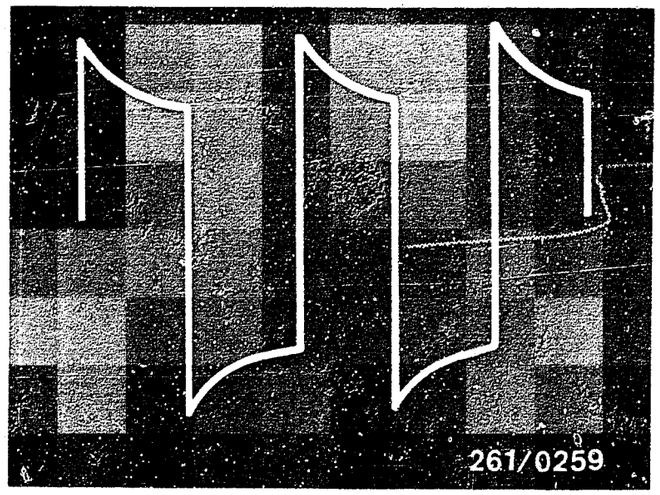
1 = BMW diagnosis connection (for diagnosis cable 1 684 463 122)
2 = Idle actuator
3 = LL adjustment screw
4 = CO adjustment screw

Arrow = Throttle-valve switch



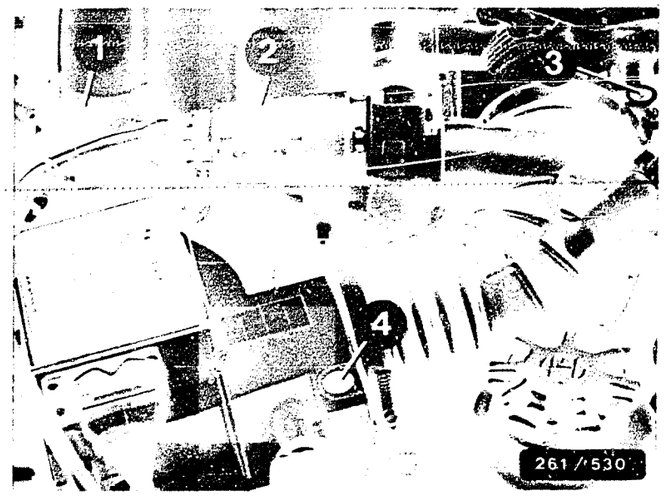
RAPID DIAGNOSIS CHART TO UNIVERSAL TEST ADAPTER (CONTINUATION)

Test step	Switch position V	Switch position Ω	Btn	Measurement and remarks	Measurement at control-unit plug between term.	Test specifications (reading)
39	17	15	–	Dwell angle at idle speed	———	6°...18°
				Dwell angle at 3000 min $^{-1}$	———	25°...45°
40	17	15	T5	Test overrun cutoff: keep speed of 2000 min $^{-1}$ constant. Press button T5. Injection signals interrupted and speed fluctuates rythmically.	2 to ground	Engine "hunts"
41	18	15	T5 and T6	On-off ratio at idle actuator with dwell-angle tester (% scale). Clip 15 of motortester to red trough. Engine at normal operating temperature runs at idle. With buttons T5 and T6 pressed, speed should be 710...760 min $^{-1}$ (if nec., adjust, see lower illustration).	33 <⟹> 5	62...72% Signal shape, see upper illustration (Oscilloscope, special input)
42	19	15	T5 and T6	As Test step 41, however, measurement at second winding of idle actuator.	34 <⟹> 5	28...38 % Signal shape, as above



Signals at idle actuator

2 = Idle actuator
3 = LL adjustment screw



TEST SPECIFICATIONS

Pressure regulator
Fuel pressure 2,3...2,7 bar

Electric fuel pump

Fuel delivery
(measured in return) at least 750 cm ^{3} /30s
Connection voltage
(under load): at least 12 V

Temperature sensor, air (NTC I)

Internal electrical resistance
measured at air-flow sensor
between term. 1 and term. 4
at ambient temperature
(+15°C...+30°C): 1,45...3,3 k Ω

Temperature sensor, engine (NTC II)

Color of plug, blue.
Internal electrical resistance

at ambient temperature
(+ 15° C...+ 30° C): 1,45...3,3 k Ω
engine at normal operating temperature
(approx. + 80° C): 280...360 Ω

Solenoid-operated injection valve
Internal electrical resistance
at ambient tempeature
(+ 15° C...+ 30° C): 15...17,5 Ω

Air-flow sensor
Internal electrical resistance between:
Term.2 and term.4 : 8...2500 Ω (*)
Term.3 and term.4 : 500...1100 Ω
(*) Deflect air-flow sensor flap as far as will go.

TEST SPECIFICATIONS (CONTINUATION)

Speed sensor and reference-mark sensor

Internal electrical resistance
at ambient temperature
(+15°C...+30°C): 0,6...1,6 k Ω

Throttle-valve switch

Resistance value of idle
contact (term. 2 / ground): 0 Ω
Resistance value of full-load
contact (term. 3 / ground): 0 Ω

For vehicle with controlled transmission shift.
(6-pin connection):
Resistance value of idle
contact (term. 4 / term. 6): 0 Ω
Resistance value of full-load
contact (term. 4 / term. 5): 0 Ω

Idle actuator

Internal electrical resistance
at +15°...+30°C
Term.3 and term.2 : 17...22,5 Ω
Term.1 and term.2 : 19...25 Ω

Low-idle-speed control.

Engine at normal operating temperature,
ambient temperature +15°...+30°C.
Switch off consuming devices.
Idle speed: 695...745 min $^{-1}$

CO concentration: 0,5...1,5 % by vol. CO

See equipment and Autodata microcard for settings for valve clearance and other engine data.

For production reasons:
continued on the following
coordinate.

INSTALLATION POSITION OF COMPONENTS

Position information always refers to the direction of vehicle travel.

* Reference-mark and engine-speed sensor:
  In the starting-motor ring gear housing on the circumference of the flywheel ring gear.

* Fuel filter:
  Underneath vehicle, near fuel tank.

* Fuel pump:
  Underneath vehicle, near fuel tank.

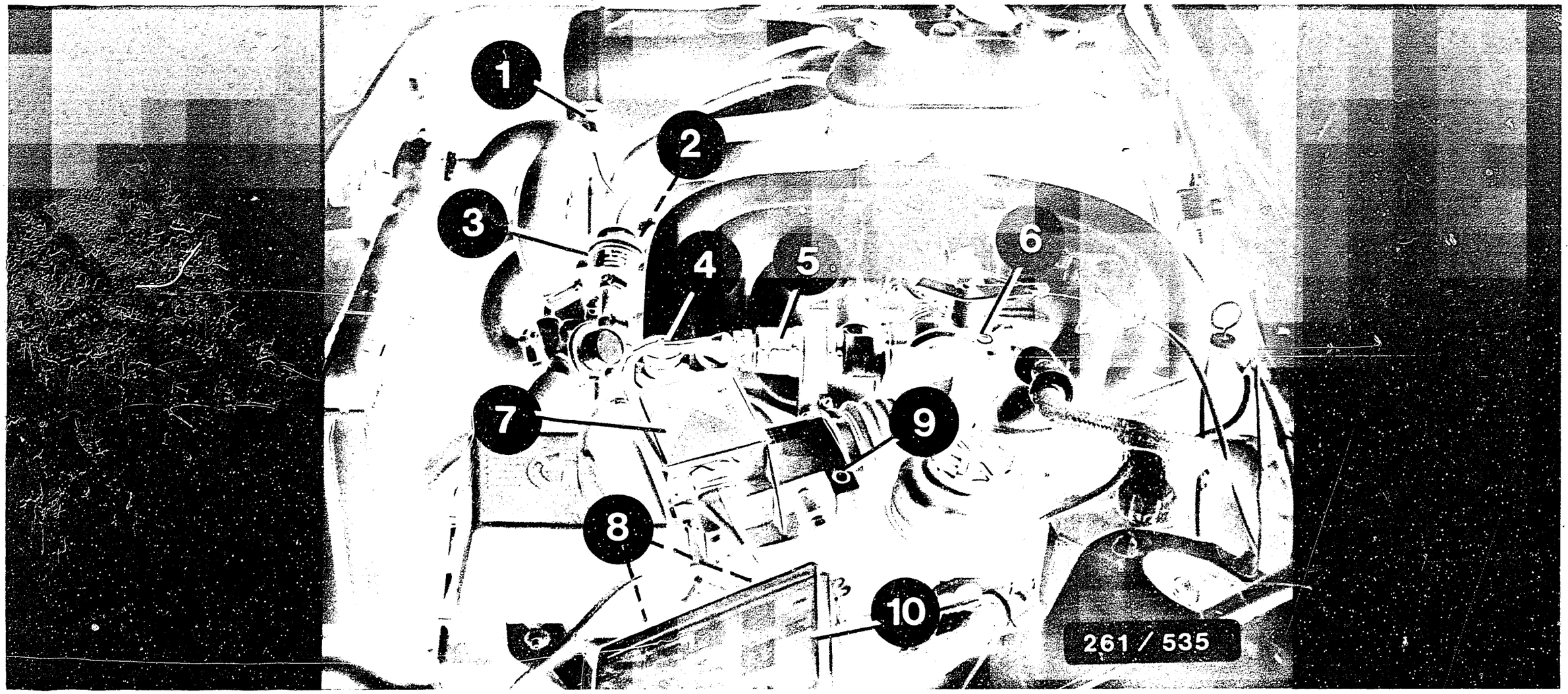
* Ground lead of electric fuel pump:
  Below rear seat, on left (inlet), ground point on vehicle body.

* Control unit:
  In glove compartment, behind covering.

* Temperature sensor I (air):
  In air-flow sensor.

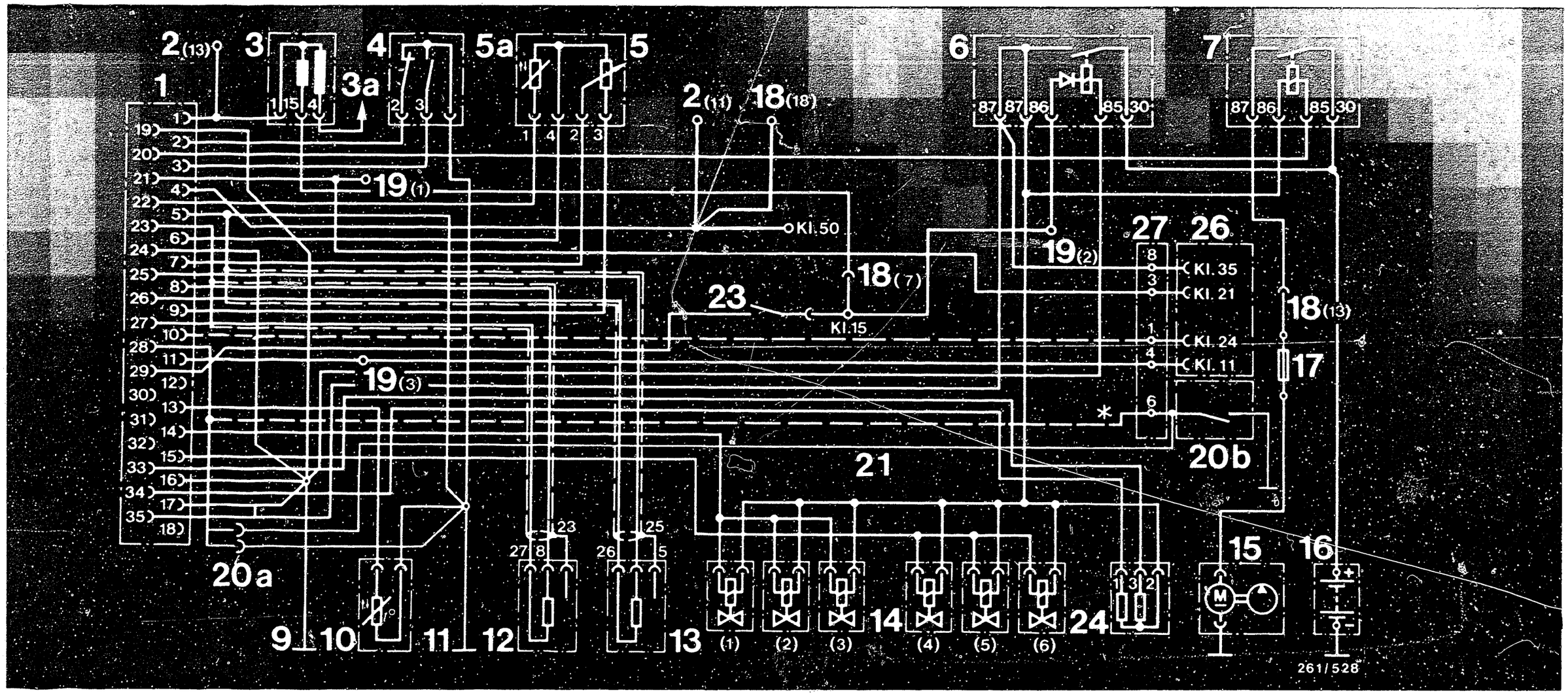
* Central ground:
  On inlet pipe of 5th cylinder.

* Throttle-valve switch:
  On lower side of throttle-valve assembly.



1 = Ignition coil
2 = Temperature sensor, engine (NTC II)
3 = Pressure regulator
4 = Diagnostic socket
5 = Idle actuator
6 = Idle-speed-adjusting screw
7 = Air-flow sensor
8 = Main and pump relays
9 = CO adjusting screw
10 = Electrics box

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

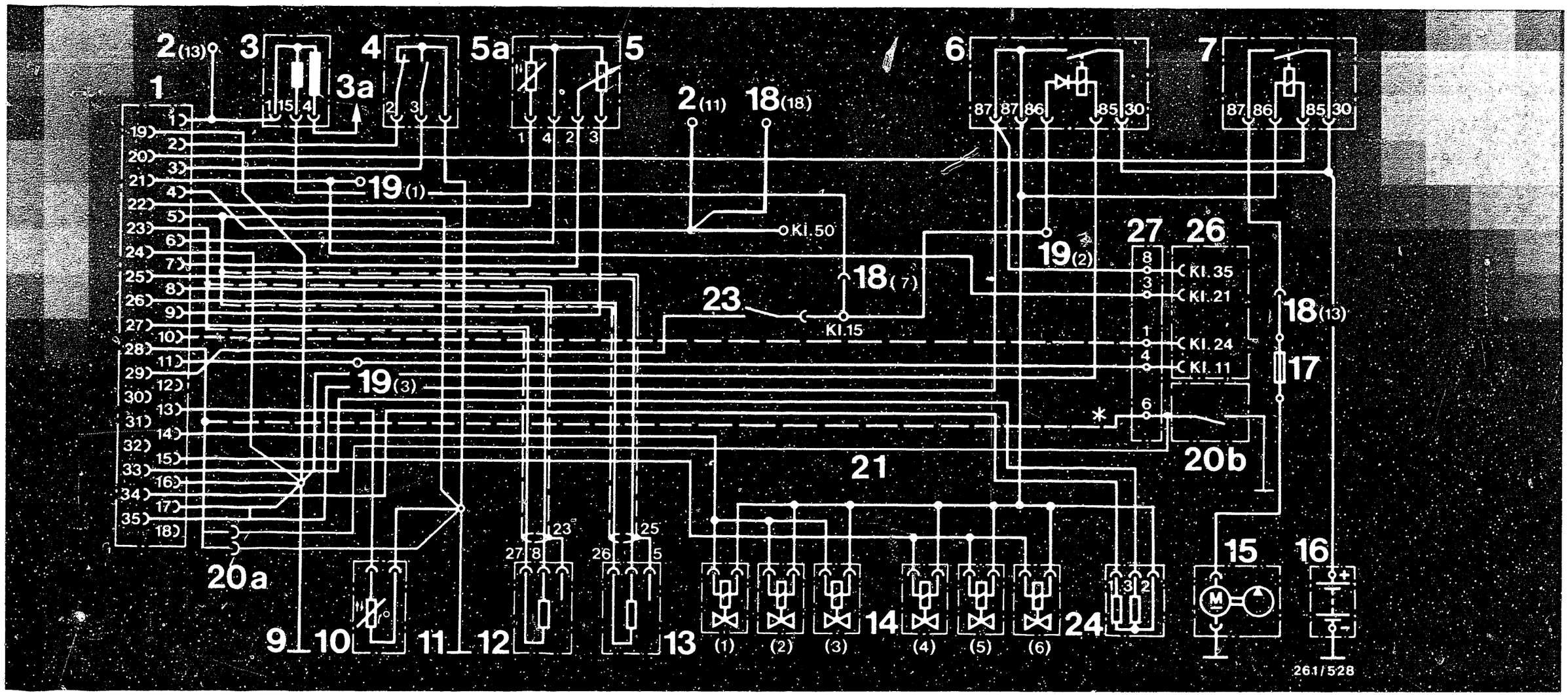


1 = Motronic control-unit plug
2 = Diagnosis plug (No.11, 13)
3 = Ignition coil
3a = to high-voltage distributor
4 = Throttle-valve switch (with potentiometer for vehicles with elec. controlled transm. shift)
5 = Air-flow sensor
5a = Temperature sensor I (air)
6 = Relay 2 (main relay with reversed-polarity protection diode)
7 = Relay 1 (pump relay)
9 = Vehicle ground for control-unit output stage
10 = Temperature sensor (coolant)
11 = Vehicle ground for control unit
12 = Speed sensor
13 = Reference-mark sensor
14 = Injection valves

ELECTRICAL TERMINAL DIAGRAM

M23 — ⟹

M24 — ⟺



15 = Fuel pump
16 = Battery
17 = Pump fuse
18 = Engine plug (No.7, 13, 18)
19 = Plug connection
(in glove compartment)
20a = Automatic and elec. controlled transmission shift:
Plug connection disconnected.
Manually-shifted transmission:
Plug connection connected
(term. 28 to ground)

20b = Automatic and electronically controlled transmission shift:
In position P and N to ground
In position D, 1, 2, 3, R, open
21 = Lead only for automatic
23 = Switch at air-conditioner compressor
24 = Idle actuator
26 = Control unit of elec. controlled transmission shift (if present)
27 = Multiple plug in glove compartment
(only with elec. controlled transm. shift)
* = dashed lines only for vehicle with elec. controlled transmission shift

ELECTRICAL TERMINAL DIAGRAM (CONTINUATION)

Always pay attention to SAFETY AND PRECAUTIONARY MEASURES in order to avoid damage to the engine, control unit or ignition coil, as well as to prevent danger to persons.

1. CAUTION!
   High-output ignition system with dangerous high and low voltages!

   Contact with components or terminals under voltage may be dangerous (both at the primary and secondary ends).

2. When testing the compression, disconnect the Motronic relay. In this way, undesired injection by the injection valves is avoided.

3. Never start engine when battery not firmly connected.

4. Incorrect polarity of the supply voltage, e.g. through incorrect connection of the battery or ignition coil, may lead to the destruction of the control unit.

5. Never use a fast charger for starting the engine. Provide starting aid only using a second 12 V battery and jump leads.
   Caution! Due to non-uniform demands of the vehicle manufacturer made on electronic products, we recommend that a 24 V battery never be used for providing starting aid. Observe the vehicle owner's manual.

6. Disconnect the battery from the vehicle electrical system before boost charging.

7. When charging the battery in the vehicle or providing starting aid, observe the instructions in the operating manual of the fast charger, as well as the instructions from the vehicle manufacturer.

8. Never disconnect the battery from the vehicle electrical system when the engine is running.

9. Never short circuit ignition coil term. 1 to ground (e.g. for switching off the engine). Ignition coil and, under certain circumstances, control unit are destroyed.

10. Never connect the positive battery terminal to ignition coil term. 1. Control unit is destroyed.

11. Never diconnect or connect wiring-harness plug of control unit when ignition is switched on.

12. When temperatures are above +80°C (drying oven), the control unit must be removed.

13. When welding (electric spot welding), the control unit must be removed.

14. When installing an alarm system, observe the installation instructions for Motronic vehicles or the SIS microcard ALL-500.
    Make sure that the alarm relay is not destroyed by external fields (e.g. from ignition cables) so that it responds in a defective manner.